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THE UNIVERSITY OF ALBERTA

AN ANALYSIS OF THE DEMAND FOR COCOA IN CANADA AND IN THE UNITED STATES, 1950-1972

by

©

NICHOLAS EGERTON SACKEY

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

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DEPARTMENT OF RURAL ECONOMY

EDMONTON, ALBERTA

FALL, 1976

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "An Analysis of the Demand for Cocoa in Canada and in the United States, 1950-1972", submitted by Nicholas E. Sackey in partial fulfilment of the requirements for the degree of Master of Science in Agricultural Economics.

Supervisor

Date. June 23, 1976

ABSTRACT

Study of the demand for cocoa in Canada and in the United States is important for decision-making purposes in the developing countries which produce and export cocoa. In this study, the variables affecting the demand for cocoa in its beverage and non-beverage uses in Canada and in the United States are examined for the period from 1950 to 1972. Single equation models are formulated to try to explain the variation in the retail prices of cocoa and in the total and per capita consumption of cocoa. The elasticities of demand for cocoa with respect to own-price, income, and the prices of related goods are calculated.

The results obtained from the study indicate that the demand functions for the beverage and non-beverage uses of cocoa in both Canada and in the United States are relatively price inelastic. The calculated own-price elasticity of demand for cocoa was $^{-}0.2643$ for Canada while the estimates of the own-price elasticity of demand ranged from $^{-}0.2856$ to $^{-}0.0963$ for the United States.

The analysis suggests that cocoa is a normal good in both uses in Canada. For the United States, cocoa is a normal good in its non-beverage use and an inferior good in its beverage use. The estimated income elasticities for the non-beverage use of cocoa were 0.4093 and 0.1797

for Canada and 0.0129 and 0.0993 for the United States. For the beverage use of cocoa, these elasticities ranged from ⁻0.0353 to ⁻0.0130 for the United States. For Canada, the value obtained was 0.4118.

The results of the analysis indicate that both soybean oil and sugar are substitutes for cocoa in Canada. The magnitudes of two significant elasticities of demand for cocoa with respect to sugar price were 0.7597 and 0.6706. Estimates of the cross-price elasticity of demand with respect to the price of soybean oil were 0.2294 and 0.2218. None of the estimated cross-price elasticities of demand were significant for the United States. Negative estimates of the elasticity of demand for cocoa with respect to the price of coffee were obtained. These suggest that cocoa and coffee are complements in the United States. Two calculated cross-price elasticities were ⁻0.2500 and ⁻0.2034. There is also a complementary relationship between cocoa and tea in the United States. The estimates of the elasticity of demand for cocoa with respect to the price of tea ranged from ⁻0.5526 to ⁻0.2396. None of these estimated elasticities were significant for Canada.

Since earnings from cocoa exports are important to the economies of a number of developing countries and in the light of the inelastic nature of the demand functions for cocoa in its non-beverage and beverage uses and the low

(and even negative) response of consumption to income there would be advantages to the producing countries in agreement for cocoa in which floor and ceiling prices are agreed upon by the contracting parties to the agreement. This could be an instrument to reduce the price instability which arises from supply fluctuations confronting the inelastic demand. Depending on the levels of floor and ceiling prices, earnings from cocoa exports could be increased. The likelihood of only slow growth in the demand for cocoa by importing countries such as Canada and the United States leads to the recommendation that there should be further processing of cocoa beans into semi-processed and finished products in the producing countries -- at least to the extent that these producing countries import such cocoa products. More emphasis on promotion of the present uses of cocoa products is required in an effort to achieve expansion of demand. In addition, emphasis should be placed on research into expanding the uses of cocoa.

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I would like to take this opportunity to thank Dr. H.C. Love, my former professor at Kumasi and the University of Science and Technology, Kumasi, Ghana, for nominating me for a Canadian Government Award, and CIDA for providing financial assistance for my graduate work in Agricultural Economics.

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CHAPTER I

INTRODUCTION

Cocoa[1] is a non-alcoholic beverage which also has non-beverage or food uses. Cocoa trees grow only in tropical countries, chiefly in West Africa. For example, Ghana, Nigeria, Brazil, the Ivory Coast, and the Cameroons, produced 79 percent of the world cocoa crop between 1960 and 1965.[2] The cocoa bean extracted from the pod of the cocoa tree is the necessary raw material for beverage cocoa, chocolate, and a great variety of chocolate-flavoured products used in food. The cocoa bean has a high fat content, which partially explains the food value of the products derived from it.[3]

Wickizer[4] distinguishes the following kinds of cocoa

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[1] The word cocoa, as used in this study, refers to cocoa beans as well as to the processed or manufactured product made from cocoa beans.

[2] J.R. Behrman, "Cocoa: A Study of the Demand Elasticities in the Five Leading Consuming Countries," Journal of Farm Economics, Vol. 47 (May, 1965), p. 410.

[3] V.D. Wickizer, Coffee, Tea, and Cocoa: An Economic and Political Analysis (Stanford, California: Stanford University Press, April, 1951).

[4] Ibid., pp. 350-352.

products and uses of cocoa. Cocoa beans are broken into particles known as cocoa nibs. Cocoa powder is the unsweetened cocoa nib which is finely ground after removal of its natural fat, known as cocoa butter. Sweet drinking chocolate is the ground cocoa nib which has been mixed with sugar and refined, while eating chocolate is a similar type of mixture in which the proportion of cocoa butter has been increased and flavouring ingredients added. Unsweetened chocolate, commonly called baking chocolate, results from the ground nibs being moulded into bars. Cocoa butter, chocolate, cocoa powder, and prepared cocoa mixes are used widely in the confectionery, ice cream, baking, dairy, and soft-drink industries to produce a great variety of foods and beverages. In addition, cocoa butter is used as a base for cosmetics and various pharmaceutical preparations.

Most cocoa is consumed in the United States, the European Economic Community countries, and to a lesser extent, in other high income countries. For example, between 1960 and 1964, the United States, the Federal Republic of Germany, the United Kingdom, France, and Canada consumed 28.5 percent, 12.6 percent, 10.4 percent, 6.1 percent, and 2.5 percent, respectively, of the world cocoa crop.[1]

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[1] J.R. Behrman, "Monopolistic Cocoa Pricing," Journal of Agricultural Economics, Vol. 50, No. 3 (August, 1968), p. 704.

The imports[1] of cocoa beans into Canada and the United States were 17.8 and 283.7 thousand metric tons, respectively, in 1970.

The Problem

For several of the producing countries, cocoa exports are a major source of foreign exchange earnings. The prices of cocoa have been subject to much fluctuation. These fluctuations suggest that the demand function for cocoa is price-inelastic. One implication of a price-inelastic demand function is that in this situation, it may be profitable for cocoa producing countries to try to limit any increases in the market supply of cocoa. It seems apparent that for decision-making purposes, administrators in both the exporting and importing countries need quantitative information regarding the demand relationships for cocoa. Information on the price elasticities of demand for cocoa may be useful in determining whether a commodity agreement would benefit producers. Since the United States is the leading importer of cocoa, estimates of the elasticities of demand in this market should be of considerable interest to cocoa producing countries. There is a need to understand more about the factors which determine the demand for cocoa in both its beverage and non-beverage uses.

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[1] Food and Agriculture Organization, Cocoa Statistics (Rome: F.A.O., October, 1974), p. 7.

Objectives

In view of the preceding factors, there are two major objectives of the study:

(1) To examine the behaviour of the important variables affecting the demand for cocoa for its beverage and non-beverage uses in both Canada and the United States. In pursuing this objective, the relationships between the consumption of cocoa and the effects of changes in income, prices of cocoa, population, and the prices of related goods are examined from 1950 to 1972; and

(2) To estimate elasticity coefficients -- price, income, and cross-price -- of the demand for cocoa in both Canada and the United States.

It is hoped that a more thorough understanding of the relationships among the factors affecting the demand functions for cocoa in Canada and the United States can help producing countries make rational production and marketing decisions.

Hypotheses

It is hypothesized that for both Canada and the United States:

(1) Changes in population levels explain a high percentage of the variation in total consumption

of cocoa;

(2) Total consumption of cocoa varies inversely with the price of cocoa;

(3) Per capita consumption varies inversely with the retail price of cocoa and directly with per capita income;

(4) Total income has a direct relationship with the total consumption of cocoa and that this factor plays a major role in explaining the total consumption of cocoa;

(5) Sugar is an important factor in explaining the variation in the consumption of cocoa;

(6) Soybean oil explains a substantial portion of the variation in consumption of cocoa;

(7) Coffee and tea are directly related to the consumption of cocoa.

Scope and Nature of the Study

The study is limited to Canada and the United States and applies to the period from 1950 to 1972. This was the period for which data on the variables considered in the study were available. Average annual data for the variables were obtained from published sources. Analysis of these time-series was done using single equation multiple regression models. Based on these models, elasticities -- price, income, and cross-price -- are calculated. Various

implications of these results for the producers in the developing countries are discussed.

Organization of the Study

In Chapter I, the problem, the objectives of the study and the hypotheses raised by the problem are outlined. Chapter II is primarily concerned with the production and marketing of cocoa in Ghana and with a discussion of factors influencing the price of cocoa. A brief history of international price and export control on cocoa is outlined. This chapter ends with a review of three studies which relate to the Canadian and the United States demand for cocoa.

Chapter III is concerned with the formulation of a number of postulated models of the demand function for cocoa in Canada and the United States. This chapter contains a discussion of the variables which were considered in the study, the data used in the study, and the models which were formulated in an attempt to explain variations in the retail prices of cocoa and variations in the total and per capita consumption of cocoa for both countries from 1950 to 1972. Chapter IV presents the results of the statistical analysis and provides a discussion of these results. This chapter includes a discussion of some implications of the results and limitations of the study. The final chapter provides an implication of the results for a commodity agreement, recommendations, and a summary.

CHAPTER II

THE WORLD COCOA ECONOMY

The Cocoa Growing Areas

Cocoa trees are grown only in tropical countries, chiefly in West Africa. Along the West African Coast cocoa trees are grown from Sierra Leone to Angola. Most of this area is within ten degrees of the Equator. The main production in West Africa is centered in Ghana, Nigeria, the Ivory Coast, the Cameroons, and Togo. The small islands in the Gulf of Guinea, especially Fernando Po, where cocoa is said to have been first introduced, are the other producers. Ghana, Nigeria, Brazil, the Ivory Coast, and the Cameroons produced 79 percent of the world cocoa crop between 1960 and 1965.[1] The above countries produce more than 100,000 tons a year.[2] Countries producing less than 100,000 tons a year but more than 10,000 tons are the Dominican Republic, Equatorial Guinea, Togo and Mexico.[3] Countries producing

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[1] J.R. Behrman, "Cocoa: A Study of Demand Elasticities in the Five Leading Consuming Countries, 1950-1961," Journal of Farm Economics, Vol. 47 (May, 1965), pp. 410-417.

[2] International Cocoa Agreement (Wellington, New Zeland: Government Printer, 1974), p. 46.

[3] Ibid.

less than 10,000 tons a year include Zaire, Phillipines, Haiti, Bolivia, Guatemala, Uganda and Angola.[1]

The average annual world cocoa bean production between the 1951/52 season and the 1955/56 season was 778,000 metric tons.[2] Of this amount, 492,300 metric tons were produced in Africa and 232,300 metric tons were produced in Ghana. These volumes of production had increased by the 1970/71 season; world production was 1.519 million metric tons, 1.107 million metric tons were produced in Africa, and 406,000 metric tons were from Ghana.[3] Grinding of cocoa beans from the 1951/52 to the 1955/56 season averaged 704,000 metric tons annually for the world, 13,000 metric tons for Africa, and 5,600 metric tons for Ghana.[4] These volumes of cocoa bean grindings had increased by 1970; the world grindings were 1.354 million metric tons, 138,300 metric tons in Africa and 43,200 metric tons for Ghana. The average annual world trade in cocoa beans amounted to 698,900 metric tons from 1952 to 1956. The average annual volume of exports from Africa over this period was 491,500 metric tons, out of which Ghana exported 224,200 metric tons.[5]

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[1] Ibid.

[2] Food and Agriculture Organization, Cocoa Statistics (Rome: F.A.O., October, 1974), p. 5.

[3] Ibid.

[4] Ibid., p. 6.

[5] Ibid.

Production and Marketing of Cocoa in Ghana[1]

Ghana's average volume of production of 232,300 metric tons over the period 1951/52 to 1955/56 represented 30 percent of world production of cocoa beans over that period. Ghana's volume of production expressed as a percentage of world output had declined to 27 percent by 1970. Cocoa is cultivated in Ghana by a very large number of farmers, each with a small holding of between five to one hundred or more acres. There are no plantations. Farmers sell their produce either to a farmer co-operative or to a licensed buying agent. The co-operatives and the licensed buying agents, in turn, sell to the Cocoa Marketing Board. The Cocoa Marketing Board is the only authorized purchaser of cocoa beans and has the power to appoint buying agents and to fix, with government approval, the prices to be paid to farmers. The Board is also responsible for transporting the produce to the ports of Takoradi and Tema and for distributing the produce to buyers both within and outside Ghana.

Factors Influencing the Price of Cocoa

The prices of cocoa have been subject to much fluctua-

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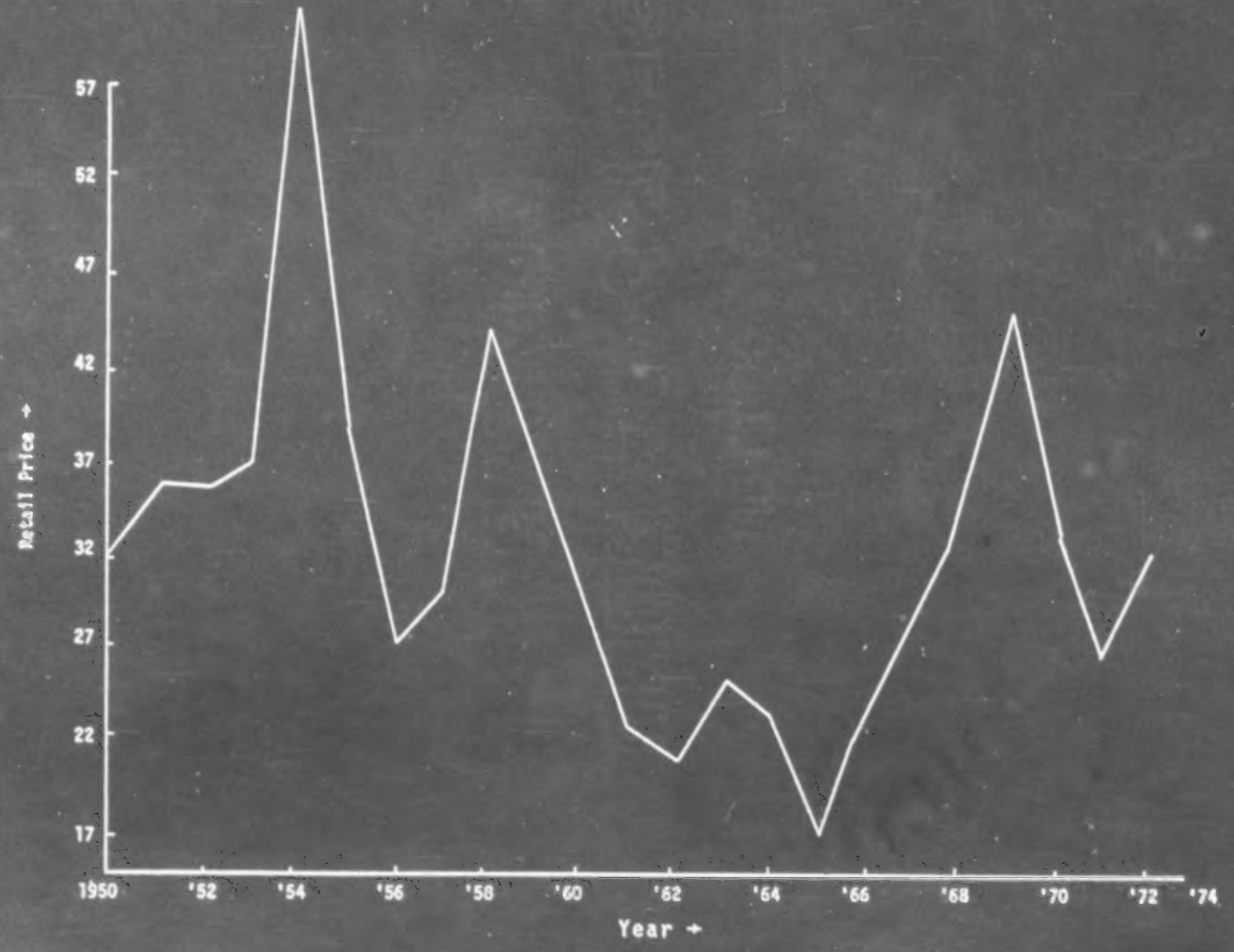
[1] Ghana is used here as an example in describing the cultivation and the movement of cocoa beans from the farmers in the producing countries to consumers in both Ghana and importing countries.

tion over time. Probable underlying factors causing these fluctuations are the relatively inelastic nature of both the supply and the demand functions for cocoa. When an inelastic supply function is confronted by changes in market demand, substantial price fluctuations can be expected. When an inelastic demand function applies, any shifts in market supply (due to weather or pests) will result in substantial price fluctuations. On the supply side, except for some new faster yielding varieties, four or five years must elapse from the time of planting until the tree begins to bear fruit. This means that production in any given year cannot be altered appreciably by new plantings. Further, cocoa bean usage does not appear to react very quickly to price changes. For instance, when high prices of cocoa prevail, it will likely take some time for manufacturers to change their manufacturing processes and use of inputs.

Changing production prospects brought about by unexpected drought, floods, or other adverse weather conditions while the crop is growing and plant disease and insect damage all make it difficult to forecast the exact amount of future supplies. Government intervention and artificial barriers such as strikes which delay the movement of cocoa from producing countries are also important in affecting the price levels of cocoa. Demand prospects are also subject to the effects of changing conditions, such as trends in the business cycle which influence the buying power of consumers. Figure 1 shows the prices of cocoa at New York

FIGURE 1

AVERAGE ANNUAL RETAIL PRICE OF COCOA IN UNITED STATES CENTS PER POUND AT NEW YORK, 1950-1972



from 1950 to 1972.

Much trading in cocoa takes place at the London and New York Cocoa Exchanges and, to a lesser extent, at the Paris and Amsterdam Terminal Markets. Cocoa Prices appear to be influenced by the speculative activity in these cocoa futures markets. According to Shisko,[1] cocoa's appeal to speculators is that it tends to have price movements which are extensive and relatively consistent. An underlying factor is likely the relatively inelastic nature of both the supply and the demand functions for cocoa.

History of International Price and Export Controls for Cocoa

Attempts by both the producing and the importing countries to control prices and exports of cocoa date back to World War II. During the war and for several years after, world cocoa supplies decreased considerably, owing mainly to the neglect of farms in the principal producing countries. Meanwhile the demand for cocoa and chocolate products, especially the demand for the food uses of cocoa, had risen considerably. In order to control and to allocate the supply that was available, the International Emergency Food Council was established and charged with the responsibi-

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[1] I. Shisko, "How to Forecast Cocoa Prices," Guide to Commodity Price Forecasting (New York: Commodity Research Bureau, Inc., May, 1971), p. 101.

lity of rationing cocoa and controlling prices.[1] This procedure continued for several years. However, in 1946, the United States did not agree to continue price controls on cocoa.

Other efforts to bring the cocoa market under control began in 1962 with the formation of the Cocoa Producers Alliance which was made up of the six leading cocoa producers of Ghana, Nigeria, Brazil, the Ivory Coast, the Cameroon Republic, and Togo. In September of 1964, an International Cocoa Agreement was put into operation by the Alliance. The aim of the Agreement was to limit exports by member countries through a system of annual and quarterly quotas and to set a minimum price of cocoa at an "indicative" or reference price level of U.S. 23.75 cents per pound. This Agreement was not successful. According to Shisko,[2] the producing countries could not raise prices owing to the fact that the importing countries had large accumulations of stocks and the producing countries had difficulty storing the supply of cocoa beans.

A new International Cocoa Agreement,[3] to which exporting and importing countries could become parties, was pro-

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[1] See V.D. Wickizer, Coffee, Tea, and Cocoa: An Economic and Political Analysis (Stanford, California: Stanford University Press, 1951), p. 347.

[2] I. Shisko, op. cit., p. 101.

[3] Further details of the Agreement are given in the last chapter.

posed on 20 October 1972 at Geneva. The stated objectives of the Agreement are:

(a) To alleviate serious economic difficulties which would persist if adjustment between the production and consumption of cocoa cannot be effected by normal market forces alone as rapidly as circumstances require;

(b) To prevent excessive fluctuations in the price of cocoa which affect adversely the long term interests of both producers and consumers;

(c) To make arrangements which will help stabilize and increase the export earnings from cocoa of producing countries thereby helping to provide such countries with resources for accelerated economic growth and social development, while at the same time taking into account the interests of consumers in importing countries;

(d) To assure adequate supplies at reasonable prices, equitable to producers and consumers; and

(e) To facilitate expansion of consumption and, if necessary, and insofar as possible, an adjustment of production, so as to secure any equilibrium in the long term between supply and demand.[1]

The Agreement came into force on 30 April 1973 and it is to last until the end of the third quota year. A quota year is from October 1 to September 30. Most of the major producing countries and the importing countries, except the United States, have ratified the Agreement. The effectiveness of the Agreement can be questioned since the leading importer of cocoa, the United States, has not ratified the Agreement. Prices in the United States are still based on those prevailing on the New York market.

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[1] International Cocoa Agreement, op. cit., p. 6.

Literature Review

This review relates to three studies relevant to the study. One of these studies was conducted by the Food and Agriculture Organization of the United Nations (F.A.O.).[1] The other two studies are by Behrman.[2]

F.A.O. Projections of the Demand for Cocoa in Canada and the United States

The F.A.O. commodity projections are a series of studies which have the general objective of attempting to quantify future trends in production, consumption, and trade of agricultural commodities. The specific objective of one section of these commodity projections is to project to 1980, on the basis of certain explicit assumptions, the demand for cocoa in Canada and the United States. Average annual data on population, income, and prices from 1964 to 1966 were used as the base year for the demand projections.

The basic assumption for the demand projections was that in Canada the population growth rate[3] of 1.8 percent per year for 1965 to 1970 would fall to 1.5 percent per year

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[1] Food and Agriculture Organization, Agricultural Commodity Projections, 1970-1980, Vol.s I and II (Rome: F.A.O., 1971).

[2] J.R. Behrman (1965), op. cit., pp. 410-417. See also J.R. Behrman, "Monopolistic Cocoa Pricing," Journal of Agricultural Economics, Vol. 50, No. 3 (August, 1968), pp. 702-719.

[3] Food and Agriculture Organization (1971), op. cit., p. xx.

for 1970 to 1975 and would remain the same from 1975 to 1980. For the United States,[1] the annual growth rate of 1.1 percent for 1965 to 1970 was not expected to change over the period from 1970 to 1975 or from 1975 to 1980. The annual gross domestic product growth rate[2] of 4.5 percent over 1965 to 1970 was expected to rise to 5.1 percent from 1970 to 1975 and fall to 4.9 percent over 1975 to 1980 for Canada. For the United States,[3] it was assumed that the gross domestic product growth rate would rise from 3.4 percent per year from 1965 to 1970 to 4.2 percent per year over 1970 to 1975 and remain constant at 4.2 percent per year from 1975 to 1980. The assumption regarding the price of cocoa in both Canada and the United States was that there would be a constant price of forty cents per pound from 1970 to 1980.[4]

The net imports of cocoa were projected to increase from 38,000 tons over 1964 to 1966 to 40,000 tons in 1970 and to 51,000 tons in 1980 for Canada.[5] In percentage terms,

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[1] Ibid.

[2] Ibid., p. xxiv.

[3] Ibid.

[4] Food and Agriculture Organization (1971), op. cit., p. 293.

[5] The projections of net import values for 1970 and 1980 for Canada are the difference between the projections for North America and the United States. There was no separate projection for Canada.

the percentage of world imports of cocoa imported by Canada was projected to increase from the 1964-66 average of 3.0 percent to 3.2 percent in 1970 and then to decrease to 3.1 percent in 1980.[1] For the United States, net imports of cocoa were projected to fall in 1970 from imports in the period 1964-66 and then rise again in 1980.[2] The volume of net imports were projected to decrease from 383,000 tons for the 1964-66 period to 355,000 tons in 1970, and then to increase to 431,000 tons in 1980. In percentage terms,[3] the percentage of world imports of cocoa purchased by the United States was projected to decrease from the 30.9 percent of the 1964 to 1966 average to 28.1 percent in 1970, and to decrease further to 26.5 percent in 1980.

These projections were less than the volumes of net imports of cocoa by both Canada and the United States in 1970. The actual net import for Canada was 17,800 metric tons[4] compared to the F.A.O. projection of 40,000 metric tons for 1970. For the United States, the net import of cocoa in 1970 was 283,700 metric tons[5] as compared to the

---

[1] Calculated from the values for North America and the United States.

[2] Food and Agriculture Organization (1962), op. cit., p. 229.

[3] Ibid.

[4] Food and Agriculture Organization (1974), op. cit., p. 7.

[5] Ibid.

355,000 metric tons projected by the F.A.O.

These projections of demand by the F.A.O. could be used for planning of production by the cocoa producing countries. These projections could also be used to allocate future quotas among the exporting countries under any commodity agreement. However, in view of the large differences between the actual and projected volumes of imports for both countries, the F.A.O. projections should be updated since the present projections cannot be relied upon.

Two Studies by Behrman

Behrman's first study[1] was concerned with estimating the elasticities of demand for cocoa in the five leading consuming countries -- United States, United Kingdom, Federal Republic of Germany, Netherlands, and France -- for the period from 1950 to 1961. In fitting a single equation model of the demand function for cocoa, Behrman postulated that the per capita consumption[2] of cocoa products was dependent on the levels of average annual per capita disposable income and the average annual domestic prices of cocoa and sugar. Behrman also developed a ten-equation

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[1] J.R. Behrman (1965), op. cit., pp. 410-417.

[2] Behrman assumed the per capita demand for grindings as representing the demand for the per capita consumption of cocoa.

simultaneous equation model.[1]

For the single equation model, Behrman's estimate of the income elasticity of demand for cocoa was ⁻1.97. The calculated price elasticity was ⁻0.40 and the cross-price elasticity of demand for cocoa with respect to the price of sugar was ⁻0.23. For the simultaneous equations model, the estimated income elasticity was ⁻1.58 and the own-price elasticity was ⁻0.11. The estimate of cross-price elasticity of demand for cocoa with respect to the price of sugar was ⁻0.49.

The main conclusions of Behrman's first study for the United States were that cocoa is an inferior good and that the demand function for cocoa is price inelastic. His study indicates that the consumption of sugar is complementary to the consumption of cocoa.

Behrman's second article, entitled "Monopolistic Cocoa Pricing",[2] was published in 1968. This article discusses probable changes in some of the relevant variables in the cocoa market if an international monopolistic cocoa pricing agreement were to be implemented. In this study, the elasticities of demand for cocoa were calculated on a per capita basis with respect to four factors. These factors were the prices of cocoa, per capita income, prices of sugar and the

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[1] Interested readers should refer to J.R. Behrman (1965), op. cit.

[2] J.R. Behrman (1968), op. cit., pp. 702-719.

prices of soybean oil. For the United States, the calculated own-price elasticity of demand for cocoa was ⁻0.25, the cross-price elasticity of demand for cocoa with respect to the price of sugar was 0.08, and the cross-price elasticity of demand for cocoa with respect to the price of soybean oil was 0.19. The estimated income elasticity was not reported. For Canada, Behrman estimated the elasticities of demand for cocoa with respect to the prices of cocoa and sugar to be ⁻0.19 and ⁻0.12, respectively. The calculated income elasticity was 0.72 and the cross-price elasticity of demand for cocoa with respect to the price of soybean oil was 0.43. The main conclusions of the study were:

(1) The estimates of the price elasticity for the derived demand for cocoa beans indicate a limited short-run response which, in turn, imply that the revenue of the cocoa producers could be increased by restricting cocoa supplies and increasing the world price.

(2) Changes in the price of sugar apparently do not affect substantially the demand for cocoa beans.

(3) The estimated cross-price elasticity of the derived demand with respect to vegetable oil prices is greater than the estimated own-price elasticity. One implication of this result is that monopolistic cocoa prices may result in considerable substitution of vegetable oil for cocoa butter.[1]

Summary

The levels of total world, African and Ghanaian production, grindings, and exports of cocoa from the 1951/52

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[1] Ibid., pp. 706-707.

season to the 1955/56 season and for 1970/71 were outlined in this chapter. Ghana was used as an example in describing the production and marketing of cocoa. The factors which appear to influence the prices of cocoa were also discussed. A brief history of international price and export controls for cocoa has been presented. A review of three studies relevant to this study was outlined. The studies were done by the F.A.O. and by Behrman. The next chapter presents the formulations of demand functions for the beverage and non-beverage uses of cocoa for Canada and the United States from 1950 to 1972.

CHAPTER III

FORMULATION OF THE DEMAND FUNCTIONS FOR THE NON-BEVERAGE AND BEVERAGE USES OF COCOA

As outlined in the Introduction, this study is concerned with examining the behavior of the important variables affecting the demand functions for the non-beverage and beverage uses of cocoa in Canada and the United States. An objective of the study is to estimate the elasticities -- price, income, and cross-price -- of demand for both uses of cocoa in both countries for the period 1950 to 1972.

Demand analysis basically attempts to determine the nature of the relationships existing among variables which influence the purchases of a commodity. The market demand curve shows how much of a commodity will be purchased, per unit of time, by consumers in the market at each possible price, other things being equal. Information regarding the market demand curve is important to producers because they need to know the quantities which can be sold at various prices in order to make rational production and marketing decisions. Producers of cocoa should also be interested in the elasticities -- price, income, and cross-price -- of demand for cocoa in its use as a beverage and as a non-beverage. Producers are concerned with such questions as the effects of an increase or a decrease in price or

income on total revenue. The answer depends on the levels of the price or income elasticities of demand.

Policy makers are also concerned with the characteristics of demand. The presence of a price inelastic demand function may, when combined with supply fluctuations, be a cause of the observed price fluctuations of cocoa. The levels of own-price and cross-price elasticities of demand for cocoa are relevant to the question of the effects of a commodity agreement for this product. Estimation of the demand functions for cocoa in Canada and the United States and the measurement of the elasticities of demand for cocoa are, therefore, relevant and important topics. Both Canada and the United States are significant cocoa consuming nations; in fact, the United States is the leading national importer and consumer of cocoa. A discussion of the variables and the models considered in the study follows.

Variables Considered in the Study

Market demand functions involve the consideration of three types of influences. These are, first, the general demand factors yielded by the theory of demand. Secondly, there may be specific factors which are peculiar to the commodity in question. Finally, there may be non-economic factors, particularly those of a social nature, which affect demand relationships. On the basis of the three board influences affecting the demand for a commodity, the follow-

ing variables were used in the study for both Canada and the United States: average annual per capita and total consumption of cocoa; average annual total and per capita income; average annual retail and wholesale prices of cocoa at New York; annual population levels; average annual retail prices of sugar and soybean oil at New York; average annual wholesale prices of coffee and tea at New York; and time. A discussion of and the justification for the use of these variables follow.

The theory of demand postulates an inverse relationship between the price and quantity demanded of a good, except in the case of Giffen goods. The demand for cocoa beans is a derived demand which is derived from consumer demand for various cocoa products. As the demand for cocoa beans is a derived demand, factors which affect the demand for the final products should be considered in analyzing the demand for cocoa beans. The most important final products are chocolate and chocolate products and beverage cocoa. Consumer demand for these final products is expected to depend on the level of total and per capita income, the prices of these final products, and the prices of major substitutes and complements.

Commodities considered to be related to cocoa in its non-beverage uses are sugar and vegetable oils. In the manufacture of chocolate and chocolate products, a substan-

tial amount of sugar is used.[1] There are a number of non-chocolate confectionary items which use sugar. Satisfactory data on the prices of the final products and the prices of other non-cocoa or non-chocolate confectionary items which use sugar were not available. The average annual retail price of refined sugar at New York was included as one of the variables in the study. Vegetable oils are used as a substitute for cocoa butter in the manufacture of compound coatings.[2] Behrman[3] notes that vegetable oils are both substitutes for and complements to cocoa beans because they may simultaneously substitute for cocoa butter and complement the relatively abundant cocoa powder. Average annual time-series data of the retail price of soybean oil at New York were used in the study for both the Canada and the United States analyses. Separate time-series data were not available for Canada. For beverage cocoa, the important substitutes appear to be coffee and tea and, maybe, soft drinks. Data on the prices of soft drinks were not available. The average annual wholesale prices of coffee

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[1] Behrman reports that in the manufacture of chocolate as much as 50 percent of the product by weight is sugar. See: J.R. Behrman, "Monopolistic Cocoa Pricing," Journal of Agricultural Economics, Vol. 50, No. 3 (August, 1968), p. 716.

[2] I. Shisko, "How to Forecast Cocoa Prices," Guide to Commodity Price Forecasting (New York: Commodity Research Bureau, Inc., May, 1971), p. 102.

[3] J.R. Behrman (1968), op. cit., p. 716.

beans and tea at New York were used for both countries.

According to studies by the Food and Agriculture Organization,[1] population and income are the major shifters of demand. Time is sometimes introduced as a proxy for non-economic factors, particularly those of a social nature, which generally appear in an economic analysis as the factors which affect changes in tastes, habits, and technology.[2]

The Models Postulated by the Study

Fox lists four questions which must be considered in deciding whether the single-equation or the simultaneous-equations approach is applicable. These questions are:

(1) Is supply of the given commodity affected by current price?

(2) Is consumption of a given commodity significantly affected by current price or by the demand for export or storage?

(3) Is consumer income significantly affected by changes in price or consumption of the given commodity?

(4) Is supply of any competing commodity affected by the current price of the given commodity?

If each of these four questions can be answered in the negative, a statistical demand function fitted by least squares should approximate the "true" or

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[1] Food and Agriculture Organization, Agricultural Commodity Projections, 1970-1980, Vol. II (Rome: F.A.O., 1962), p. xxxiii.

[2] R. Stone, "The Analysis of Market Demand," Journal of Royal Statistical Society, Vol. 108 (1945), p. 291.

> structural demand function. If an analyst has serious reservations on any of these questions, it may be necessary to fit a set of simultaneous equations.[1]

The answers to these questions as they apply to cocoa appear to be negative. The long gestation period does not permit harvesting to be greatly affected by current price levels. The extent of consumption and storage may be affected by the price of cocoa but there is no demand for the export of cocoa from Canada and the United States. Consumer income is not affected by changes in the prices or the consumption of cocoa. Studies by Behrman[2] and Weymar[3] indicate that changes in the prices of sugar and soybean oil do not greatly affect the consumption of cocoa.

In terms of the preceding framework, single-equation models, which attempt to explain the extent of variation in each of the annual average retail prices, per capita consumption levels, and the levels of total consumption of cocoa in its non-beverage use, were formulated. A number of models were also postulated in an attempt to explain the

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[1] K.A. Fox, The Analysis of Demand for Farm Products, U.S.D.A. Technical Bulletin No. 1081 (Washington: U.S.D.A., May, 1953), pp. 11-14.

[2] J.R. Behrman (1965), op. cit; "Cocoa: A Study of Demand Elasticities in the Five Leading Consuming Countries, 1950-1961," Journal of Farm Economics, Vol. 47, Part 1 (1965).

[3] F.H. Weymar, The Dynamics of the World Cocoa Market (Cambridge, Massachusetts: The M.I.T. Press, 1968).

extent of variation in the total consumption of beverage cocoa. All the models are fitted separately for Canada and for the United States over the period 1950 to 1972. The single-equation models were tested in both linear and logarithmic formulations. The linear forms are presented in this chapter. The logarithmic forms are presented in Appendix A.

Single-Equation Models: Non-Beverage Use of Cocoa

Model 1

According to Fox,[1] if the purpose of an analysis is to estimate the elasticity of demand and other structural coefficients, a least-squares regression with price considered as the dependent variable and the other variables assumed to be independent may give an unbiased estimate if, and only if, current supply and other independent variables are not measurably affected by price during the marketing period. These conditions appear to be met for cocoa. Accordingly, in Model 1, it was assumed that the retail price of cocoa is the dependent variable. Total consumption of cocoa was considered to be the independent variable. Model 1 was tested, as with the other models, in linear and logarithmic formulations and for both Canada

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[1] K.A. Fox, op. cit., p. 9.

and the United States. Model 1 states that:

$$Y_1 = b_0 + b_1 Y_2 + u \qquad (1)$$

where Y_1 = the average annual retail price of cocoa at New York in U.S. cents per pound,

Y_2 = the total consumption of cocoa measured as domestic disappearance of cocoa in million pounds for the United States, and as gross disposition of cocoa in thousand tons for Canada.

Model 2

Since the direction of causality in the price-quantity relationship is debatable, a second model, Model 2, was formulated where it was assumed that the total consumption was the dependent variable and that the retail price of cocoa was the independent explanatory variable. In the linear formulation, Model 2 is:

$$Y_2 = b_0 + b_2 Y_1 + u \qquad (2)$$

where Y_2 = total consumption of cocoa measured as previously,

Y_1 = the average annual retail price of cocoa measured as previously.

Model 3

Total consumption of cocoa was hypothesized as the dependent variable. The retail prices of cocoa and total

income were postulated as the independent explanatory variables in Model 3. Model 3 may be written in linear form as:

$$Y_2 = b_0 + b_2Y_1 + b_3X_3 + u \qquad (3)$$

where Y_2 = total consumption of cocoa measured as previously,

Y_1 = the average annual retail price of cocoa measured as previously,

X_3 = total income measured in billions of dollars for the United States, and in millions of dollars for Canada.

Model 4

In this model it was postulated that the total consumption of cocoa was dependent on the retail price, total income, and population. Model 4 states that:

$$Y_2 = b_0 + b_2Y_1 + b_3X_3 + b_4X_4 + u \qquad (4)$$

where Y_2 = total consumption of cocoa,

Y_1 = average annual retail price of cocoa,

X_3 = total income,

X_4 = national population levels measured in thousands for both Canada and the United States.

Model 5

In Model 5, total consumption of cocoa was postulated as the dependent variable. The retail prices of cocoa,

total income, population, the retail prices of sugar and soybean oil were hypothesized as the independent explanatory variables. The linear form of Model 5 is:

$$Y_2 = b_0 + b_2Y_1 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + u \qquad (5)$$

where Y_2 = total consumption of cocoa,

Y_1 = average annual retail price of cocoa,

X_3 = total income,

X_4 = national population,

X_5 = the average annual retail price of refined cane sugar at New York measured in U.S. cents per pound,

X_6 = the average annual retail price of refined soybean oil at New York measured in U.S. cents per pound.

Model 6

In this model it was hypothesized that total consumption of cocoa was dependent on the retail prices of cocoa, total income, population, the retail prices of sugar and soybean oil, and time. Model 6 is written as:

$$Y_2 = b_0 + b_2Y_1 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + u \qquad (6)$$

where Y_2 = total consumption of cocoa,

Y_1 = the average annual retail prices of cocoa,

X_3 = total income,

X_4 = population,

X_5 = average annual retail prices of sugar,

X_6 = average annual retail prices of soybean oil,

X_7 = time in years.

Model 7

In Model 7, the per capita consumption of cocoa was hypothesized as the dependent variable. The independent explanatory variables were postulated to be the average annual retail prices of cocoa and per capita income. Model 7 states that:

$$Y_3 = b_0 + b_2 Y_1 + b_8 X_8 + u \qquad (7)$$

where Y_3 = per capita consumption of cocoa measured as the per capita disposition of green beans in pounds per annum for Canada, and measured in bean equivalent in pounds per annum for the United States,

Y_1 = average annual retail price of cocoa,

X_8 = per capita income measured in current dollars.

A priori expectations about the signs on the coefficients of the independent variables are as follows:

(1) The estimated coefficient on the retail price of cocoa variable, b_2, and the estimated coefficient on the consumption variable, b_1, are expected to be negative.

(2) The estimated coefficient on the total income

variable, b_3, is expected to be positive.

(3) The estimated coefficient on the population variable, b_4, is expected to be positive.

(4) The question of the sign of the estimated coefficient on the sugar price variable, b_5, is not so obvious. This is because in the manufacture of chocolate and chocolate products, some amount of cocoa and some amount of sugar are required. The proportions of these in the manufacturing mix can be varied to some extent, depending on the prices and availability of each item. Thus, cocoa and sugar are complements up to some point, and beyond this point, they become partial substitutes.

(5) The sign of the estimated coefficient on the soybean oil, b_6, is also not so obvious. Soybean oil can be a substitute for cocoa butter and also complements the use of cocoa powder.

(6) The estimated coefficient on the variable by time, b_7, is expected to be positive.

Single-Equation Models: Beverage Use of Cocoa

In regard to the beverage use of cocoa, the following models were formulated. The models attempt to explain the variation in total consumption of cocoa in its beverage use

for both Canada and the United States from 1950 to 1972.

Model 1

In this model, it was postulated that total consumption of cocoa was dependent on the wholesale prices of cocoa, coffee, and tea. This model was tested on both the Canadian and the United States data, as is the case for all the other models. In the linear form Model 1 is:

$$Y_2 = b_0 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u \qquad (8)$$

where Y_2 = total consumption of cocoa,

X_9 = the average annual wholesale price of Ghanaian cocoa beans at New York expressed in U.S. dollars per hundred pounds,

X_{10} = the average annual wholesale price of Brazilian raw coffee at New York expressed in U.S. dollars per hundred pounds,

X_{11} = the average annual wholesale price of Sri Lanka-Indian tea at New York expressed in U.S. dollars per hundred pounds.

Model 2

Model 2 hypothesizes that the total consumption of cocoa is dependent on the wholesale prices of cocoa, coffee, and tea, and total income. Model 2 may be written as:

$$Y_2 = b_0 + b_3X_3 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u \qquad (9)$$

where Y_2 = total consumption of cocoa,
X_3 = total income,
X_9 = the average annual wholesale price of cocoa,
X_{10} = the average annual wholesale price of coffee,
X_{11} = the average annual wholesale price of tea.

Model 3

In Model 3, total consumption of cocoa was postulated as the dependent variable. Total income, population, and the wholesale prices of cocoa, coffee, and tea were hypothesized as the independent explanatory variables. The linear formulation of the model is:

$$Y_2 = b_0 + b_3X_3 + b_4X_4 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u \qquad (10)$$

where Y_2 = total consumption of cocoa,
X_3 = total income,
X_4 = population,
X_9 = the average annual wholesale price of cocoa,
X_{10} = the average annual wholesale price of coffee,
X_{11} = the average annual wholesale price of tea.

Model 4

In this model it was postulated that total consumption of cocoa was dependent on the wholesale prices of cocoa, coffee, and tea, total income, population, and time. In

equation form, Model 4 is:

$$Y_2 = b_0 + b_3X_3 + b_4X_4 + b_7X_7 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u \qquad (11)$$

where Y_2 = total consumption of cocoa,
X_3 = total income,
X_4 = population,
X_7 = time in years,
X_9 = the average annual wholesale price of cocoa,
X_{10} = the average annual wholesale price of coffee,
x_{11} = the average annual wholesale price of tea.

A priori expectations about the signs of the estimated coefficients on the explanatory variables are that:

(1) The estimated coefficient on the wholesale price of cocoa variable, b_9, is expected to be negative.

(2) The estimated coefficient on the variable of the total income, b_3, is expected to be positive.

(3) The estimated coefficient on the population variable, b_4, is expected to be positive.

(4) The estimated coefficient on the variable of the wholesale price of coffee, b_{10}, is expected to be positive since coffee is an important non-alcoholic beverage.

(5) The estimated coefficient on the wholesale price

of tea variable, b_{11}, is expected to be positive since tea is an important non-alcoholic beverage.

The Data

The time period covered by the study is from 1950 to 1972 for both Canada and the United States. This is the period for which data on all the variables considered in the study are available. The data are in the form of annual averages and are obtained from published sources. The data are listed in Appendix B to F. Further information on the sources of the data is given below and in these Appendices.

Canada

Data on Canadian population are from Statistics Canada publications. The same source gives data on total gross disposition and per capita disposition of cocoa. Data on the retail prices of cocoa were obtained from Cocoa Statistics, published by the Food and Agricultural Organization of the United Nations. Total income data are from the Canada Year Book. Agricultural Statistics, published by the United States Department of Agriculture, gives data on sugar prices and soybean oil prices. The wholesale prices of cocoa, coffee, and tea are obtained from International Financial Statistics, published by the International Monetary Fund.

United States

Data on per capita consumption of cocoa, and total consumption of cocoa are from Food Consumption, Prices, Expenditures, published by the United States Department of Agriculture. Retail price of cocoa data are obtained from Cocoa Statistics, published by the Food and Agricultural Organization of the United Nations. Data on sugar prices, and soybean oil prices are obtained from Agricultural Statistics, published by the United States Department of Agriculture. Population data are obtained from Statistical Abstract of the United States, published by the United States Department of Commerce. The same source gives data on per capita income and total income. International Financial Statistics, published by the International Monetary Fund gives data on the wholesale prices of cocoa, coffee, and tea.

In summary, the variables which are considered relevant to the formulation of demand functions for the non-beverage and beverage uses of cocoa in Canada and the United States have been discussed. A number of models have been formulated and will be tested in an attempt to explain the variation in each of the retail prices and the per capita and total consumption of cocoa in its non-beverage uses, and the total consumption of cocoa in its beverage uses. Finally, the data used in the study have been outlined. The results of the statistical analyses and a discussion of these results form the subject of the next chapter.

CHAPTER IV

RESULTS OF THE STATISTICAL ANALYSIS

In this chapter, the results of the statistical analysis of the factors affecting both the total consumption of cocoa in its beverage and non-beverage uses and the per capita consumption of non-beverage use of cocoa are presented. The economic implications of these results are discussed. The statistical significance of the various postulated models was tested using the F-test. In most cases, those estimated equations which had high values of R^2, the coefficient of determination, also had high F-values. In a small number of cases, the F-test indicated that the estimated equations were highly significant even though several of the estimated coefficients on the explanatory variables were not significant. The test of significance for the individual estimated coefficients were carried out using the T-test technique.[1] The results and a discussion of these follow.

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[1] Discussion of the F-ratio, R^2, and T-ratio may be found in standard texts on econometrics. For example, see: J.L. Murphy, Introductory Econometrics (Homewood, Illinois: Richard D. Irwin, Inc., 1973).

Results and Discussion: The Demand for the Non-Beverage Uses of Cocoa

Model 1

In this model, the retail price of cocoa was postulated as the dependent variable and the total consumption of cocoa was hypothesized as the independent variable. As with all the models, this model was fitted to data for both Canada and the United States. The results are presented in Table 1.

For Canada, the signs of the estimated coefficients in both the linear and logarithmic formulations of the model were negative as expected and these coefficients were significant at the 5 percent level. The F-test indicated that both the linear and logarithmic formulations of Model 1 were not significant at the 10 percent level and the percentage of the variation in retail price of cocoa which was explained by the model was only 7.97 percent for the linear formulation and 9.87 percent for the logarithmic formulation. The Durbin-Watson test for auto-correlation was indeterminate for the linear equation but indicated that the error terms were positively auto-correlated in the logarithmic formulation. The F-test and the low level of R^2 for Model 1 indicate that total consumption does not adequately explain the variation in retail prices of cocoa in Canada.

When the model was tested on data for the United

TABLE 1

RESULTS OF MODEL 1: NON-BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_1	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	43.2435	-0.4552** (0.3375)	7.97	d	1.09
	Logarithmic	2.0054	-0.3734** (0.2463)	9.87	d	0.91
United States	Linear	57.6597	-0.0366*** (0.0160)	20.05	b	1.08
	Logarithmic	3.7617	-0.8000*** (0.3308)	21.79	b	0.87

The standard errors of the estimated regression coefficients are in parentheses.

*** The t-test indicates that the estimated coefficient is significant at the 1 percent level.

** The t-test indicates that the estimated coefficient is significant at the 5 percent level.

* The t-test indicates that the estimated coefficient is significant at the 10 percent level. The absence of asterisks indicates that coefficients are not significant at the 10 percent level.

a The F-test indicates that the equation is significant at the 1 percent level.

b The F-test indicates that the equation is significant at the 5 percent level.

c The F-test indicates that the equation is significant at the 10 percent level.

d The F-test indicates that the equation is not significant at the 10 percent level.

States, the signs of the estimated coefficients were negative as expected and these coefficients were significant at the 1 percent level. The F-test indicated that both the linear and logarithmic formulations of the model were significant at the 5 percent level, and in terms of R^2, these formulations explained 20.05 percent and 21.79 percent of the variation in retail price of cocoa, respectively. The test for auto-correlation in the linear formulation was indeterminate but positive auto-correlation occurred in the logarithmic formulation. Though the estimated coefficients are highly significant, the low level of significance of the model may be partly due to the presence of auto-correlation.

Model 2

In Model 2, total consumption of cocoa was postulated as dependent on retail prices. The results are presented in Table 2.

For the Canadian data, the results showed that the estimated coefficients in both the linear and logarithmic formulations of Model 2 were negative as expected and these coefficients were significant at the 5 percent level. The R^2 for the linear and logarithmic formulations were 7.97 percent and 9.87 percent, respectively, and these formulations of Model 2 were not significant at the 10 percent level. There was positive auto-correlation in both formulations.

It may be concluded that for Canada the retail price

TABLE 2

RESULTS OF MODEL 2: NON-BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_2	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	30.0414	-0.1751** (0.1298)	7.97	d	0.40
	Logarithmic	1.7709	-0.2643** (0.1743)	9.87	d	0.46
United States	Linear	872.4983	-5.4715** (2.3843)	20.05	b	0.26
	Logarithmic	3.2439	-0.2723** (0.1126)	21.79	b	0.26

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

of cocoa does not play a significant role in explaining the variation in total consumption of cocoa. Again, the non-significance of the model may be due partly to auto-correlation.

For the United States data, the estimated coefficients carried the expected signs and they were highly significant. The linear and logarithmic formulations had a lower level of significance and the variation in total consumption which is explained by the model is 20.05 percent in the linear formulation and 21.79 in the logarithmic formulation. Both formulations of Model 2 for the United States suffered from positive auto-correlation.

In conclusion, retail prices do not appear to play a major role in explaining the variation in total consumption of cocoa in the United States. The results may have been affected by auto-correlation.

Model 3

Total consumption of cocoa was hypothesized as the dependent variable and retail price of cocoa and total income were postulated as the independent variables in Model 3. The results of the model are presented in Table 3.

For Canada, all the estimated coefficients in the linear and logarithmic formulations of Model 3 were of the expected signs. The F-test indicated that both the linear and logarithmic formulations were highly significant and these formulations had high values of R^2 -- 86.51 percent for

TABLE 3

RESULTS OF MODEL 3: NON-BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_2	Regression Coefficients b_3	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	16.9877	-0.0799 (0.0517)	0.0002*** (0.0000)	86.51	a	2.29
	Logarithmic	-0.4019	-0.0797 (0.0823)	0.4093*** (0.0456)	82.05	a	2.24
United States	Linear	741.2674	-4.5277** (2.2187)	0.2209** (0.0975)	36.39	a	0.77
	Logarithmic	3.3270	-0.2857*** (0.1120)	-0.0249 (0.0233)	26.03	b	0.06

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

the linear formulation, and 82.05 percent for the logarithmic formulation. The test of significance for the estimated coefficients indicated that the estimated income coefficient was highly significant[1] and the retail price coefficient was not significant in both formulations of Model 3. There was no evidence of auto-correlation. It may be concluded that while retail prices are not important, total income is important in explaining the variation in total consumption of cocoa in Canada.

For the United States, the estimated coefficients had the expected signs and these coefficients were significant at the 5 percent level in the linear formulation. In the logarithmic formulation, the estimated retail price coefficient had a negative sign as expected and was highly significant while the estimated income coefficient also had a negative sign, which was opposite to expectations. The linear formulation of Model 3 was significant at the 1 percent level while the logarithmic formulation was significant at 5 percent. However, the value of the R^2 was low in both formulations -- 36.39 percent in the linear formulation, and 26.03 percent in the logarithmic formulation. The two formulations exhibited positive auto-correlation

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[1] Out of a total R^2 of 86.51 percent in the linear formulation of Model 3, the estimated income coefficient explained 84.90 percent and the estimated price coefficient explained 1.61 percent.

but there was no evidence of multi-collinearity[1] in them. One concluded that Model 3 is not useful, implying that in the United States, retail prices and total income explain only a minor portion of the variation in total consumption of cocoa based on this particular model specification and data.

Model 4

In this model it was postulated that total consumption of cocoa was dependent on the retail price of cocoa, total income, and population. Table 4 gives the results of the analysis.

For Canada, the signs of the estimated coefficients in both the linear and logarithmic formulations were as expected. However, in the linear form it was only the estimated income coefficient which was highly significant; the estimated coefficients of the retail price of cocoa and the population variables were not significant. In the logarithmic formulation none of the three estimated coefficients were significant. However, the F-test indicated that the two formulations were highly significant. The R^2 was 96.94 percent in the linear form and 82.33 percent in the logarithmic formulation. The estimated income and

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[1] The simple correlation coefficients between the estimated income and retail price of cocoa coefficients were -0.19 and -0.11, respectively, in the linear and logarithmic formulations.

TABLE 4

RESULTS OF MODEL 4: NON-BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_2	b_3	b_4	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	10.2080	-0.0587 (0.0596)	0.0002*** (0.00006)	0.0005 (0.0006)	86.94	a	2.32
	Logarithmic	-1.7879	-0.0543 (0.0956)	0.2791 (0.2407)	0.4592 (0.8324)	82.33	a	2.22
United States	Linear	-210.6450	-2.1143 (1.2860)	-0.0637 (0.0687)	0.0055*** (0.0055)	81.27	a	0.62
	Logarithmic	-3.5021	-0.1216** (0.0651)	-0.0177 (0.0651)	1.2486*** (0.0126)	79.60	a	0.66

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

population coefficients were collinear[1] in both formulations of the model. There was no evidence of auto-correlation. The addition of the population variable to the explanatory variables did not affect the magnitude of the R^2. On adding population to the set of explanatory variables, the coefficient on the retail price of cocoa variable increased in magnitude while there was no change in the value of the income coefficient in the linear form.[2] In the logarithmic form,[3] while an increase occurred in the magnitude of the retail price coefficient, a decrease occurred for the income coefficient. It may be concluded that in terms of the R^2 obtained, the model is useful. The non-significance of the estimated income and population coefficients may be due to the multi-collinearity occurring between them.

In both the linear and the logarithmic formulations, for the United States, the estimated retail price and population coefficients carried the expected signs while the estimated income coefficient carried a sign opposite to that expected. In the linear formulation, the estimated

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[1] The simple correlation coefficients between the estimated income and population coefficients were 0.94 and 0.98, respectively, for the linear and logarithmic forms of Model 4.

[2] In the linear form, the estimated retail price of cocoa coefficient increased from -0.0799 to -0.0587.

[3] In the logarithmic form, while the income coefficient decreased from 0.4093 to 0.2791, the retail price coefficient increased from -0.0797 to -0.0543.

retail price of cocoa and the income coefficients were not significant while the estimated population coefficient was highly significant. In the logarithmic formulation, the estimated retail price of cocoa coefficient was significant at 5 percent, while the significance level of the estimated income and population coefficients remained unchanged. The R^2 was 81.27 percent in the linear formulation and 79.60 percent in the logarithmic formulation. While multicollinearity did not occur, the two formulations of Model 4 exhibited positive auto-correlation. There was a significant increase in the R^2 when population was included as an explanatory variable.[1] In the linear formulation, the estimated income coefficient decreased in magnitude while an increase occurred in the magnitude of the estimated retail price coefficient,[2] and in the logarithmic formulation, both the estimated retail price of cocoa and income coefficients increased in magnitude.[3] It may be concluded

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[1] For example, the R^2 in the linear formulation of Model 3 using retail price of cocoa and total income as explanatory variables was 36.39 percent while the R^2 in the linear form of Model 4 using retail price of cocoa, total income, and population as explanatory variables was 81.27 percent, an increase of 44.88.

[2] In the linear formulation, the estimated income coefficient decreased from 0.2209 to -0.0543 and the magnitude of the retail price of cocoa coefficient increased from -4.5277 to -2.1143.

[3] In the logarithmic formulation, the estimated total income coefficient increased from -0.0249 to -0.0177 and the retail price of cocoa coefficient increased from -0.2857 to -0.1216.

that of the three explanatory variables, population[1] is the most important variable in explaining the variation in the total consumption of cocoa in the United States.

Model 5

In Model 5, total consumption of cocoa is postulated as the dependent variable, and the retail price of cocoa, total income, population, the price of sugar, and the price of soybean oil are hypothesized as the independent variables. The results are given in Table 5.

The results of the analysis of the Canadian data indicated that all the signs of the estimated coefficients were as expected in the linear formulation of the model. While the F-test indicated that the R^2 (90.13 percent) for the linear form was highly significant, none of the estimated coefficients, except the sugar price coefficient, were significant. In the logarithmic form all the estimated coefficients, except the income coefficient, were of the expected signs. Again, none of the estimated coefficients were significant though the R^2 was 86.98 percent. The presence of the high levels of the R^2 for both the linear and logarithmic forms while the estimated coefficients were not highly significant might be due to multi-collinea-

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[1] The population variable contributed 77.67 percent of the total variation of 81.27 percent in the linear formulation while the estimated retail price of cocoa and total income contributed 2.75 percent and 0.85 percent, respectively.

TABLE 5

RESULTS OF MODEL 5: NON-BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_2	b_3	b_4	b_5	b_6	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	-19.1932	-0.0402 (0.0549)	0.0000 (0.0000)	0.0013 (0.0010)	1.7815** (0.8977)	0.3018 (0.2395)	90.13	a	2.27
	Logarithmic	-6.4186	-0.0318 (0.0878)	-0.2997 (0.3324)	1.9325* (1.1695)	-0.7597** (0.4330)	0.2294* (0.1444)	86.98	a	2.27
United States	Linear	-341.9900	-2.5769** (1.3120)	-0.0383 (0.0719)	0.0056*** (0.0022)	4.5271 (2.5083)	5.4522 (3.9884)	83.72	a	0.80
	Logarithmic	-2.6757	-0.1376** (0.0695)	-0.0112 (0.0147)	1.0423** (0.5773)	0.2075 (0.3793)	0.0528 (0.0949)	80.56	a	0.73

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

rity.[1] There was no evidence of auto-correlation in the two formulations. The effects of adding sugar and soybean oil prices to the set of explanatory variables on the magnitude of the retail price, total income, and population coefficients were that in both the linear[2] and logarithmic[3] formulations, while there were increases in the estimated retail price of cocoa and population coefficients, the total income coefficient decreased in value. Though the estimated coefficient[4] on the sugar price variable is only significant at 5 percent, this variable appears to be the most important factor explaining a great portion of the variation in the total consumption of cocoa in Canada. The presence of multi-collinearity among three of the variables may, however, have affected the results.

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[1] In the linear equation, the simple correlation coefficients between the estimated population and income coefficients, the population and time coefficients, and the income and time coefficients were 0.94, 1.00, and 0.96, respectively.

[2] In the linear equation, the estimated retail price of cocoa increased from -0.0587 to -0.0402; the total income coefficient decreased from 0.0002 to 0.0000; the population coefficient increased from 0.0005 to 0.0013.

[3] In the logarithmic formulation, the retail price of cocoa increased from -0.0543 to -0.0318; the total income coefficient decreased from 0.2791 to -0.2997; and the population coefficient increased from 0.4592 to 1.9325.

[4] In the linear formulation, the sugar price variable contributed 85.75 percent out of an R^2 of 90.13 percent; 0.92 percent, 0.08 percent, 0.91 percent, and 2.45 percent were the respective contributions to R^2 of the retail price of cocoa, soybean oil price, population, and total income variables.

For the United States, also, all the estimated coefficients, except the income coefficient, bore the expected signs. In the linear equation, it was only the population coefficient which was highly significant. The estimated coefficient of the retail price variable was significant at the 5 percent level. The coefficients on the total income, sugar price, and soybean oil price variables were not significant. In the logarithmic formulation, the estimated retail price of cocoa and population coefficients were significant at 5 percent while the income, sugar price, and soybean oil price coefficients were not significant. Both formulations of Model 5 were highly significant. The R^2 was 83.72 percent for the linear formulation and 80.56 percent for the logarithmic formulation. There was multi-collinearity[1] in both formulations. The Durbin-Watson test was indeterminate. When sugar and soybean oil prices were added as explanatory variables, the estimated income and population coefficients increased in value while the retail price coefficient decreased in value in the linear formulation.[2] In the logari-

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[1] The simple correlation coefficient between the estimated population and the time coefficients was 0.95.

[2] In the linear formulation, the estimated retail price of cocoa coefficient decreased from -2.1143 to -2.5769; the total income coefficient increased from -0.0637 to -0.0383; and the population coefficient increased from 0.0055 to 0.0056.

thmic formulation,[1] there were decreases in the magnitudes of the retail price and population coefficients, and an increase in the estimated income coefficient. In conclusion, the population[2] variable appears to be the most important factor explaining the variation in the total consumption of cocoa in the United States.

Model 6

In this model it was hypothesized that total consumption of cocoa was dependent on the retail price of cocoa, total income, population, sugar and soybean oil prices, and time. The results of this model are presented in Table 6.

For Canada, all the estimated coefficients, except the time coefficient, were of the expected signs in the linear formulation. The estimated coefficients, except for the total income and time coefficients, also had the expected signs in the logarithmic formulation. The coefficients in both formulations, except for the estimated population coefficient in the logarithmic formulation, were not significant. The R^2 was 90.28 percent in the linear formulation and 88.62 percent in the logarithmic formulation. There was multi-

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[1] In the logarithmic formulation, the retail price of cocoa decreased from -0.1216 to -0.1376; the total income coefficient increased from -0.0177 to -0.0112; and the population coefficient decreased from 1.2486 to 1.0423.

[2] For example, in the linear formulation, out of an R^2 of 83.72 percent, population contributed 77.67 percent.

TABLE 6

RESULTS OF MODEL 6: NON-BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_2	b_3	b_4	b_5	b_6	b_7	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	-82.6842	-0.0476 (0.0581)	0.0001 (0.0002)	0.0058 (0.0093)	1.9383** (0.9712)	0.3166 (0.2468)	-2.1007 (4.2361)	90.28	a	2.23
	Logarithmic	-11.0475	-0.0025 (0.0868)	-0.4263 (0.3310)	3.2043*** (1.4041)	0.6707** (0.4214)	0.2218** (0.1393)	-0.1419** (0.0934)	88.62	a	2.37
United States	Linear	4760.2721	-4.1281*** (1.5275)	-0.0306 (0.0691)	-0.0265* (0.0185)	-5.7671 (22.0842)	-2.4795 (5.9167)	83.8513** (48.2068)	86.31	a	0.99
	Logarithmic	-14.0204	-0.0969*** (0.0404)	-0.0129* (0.0054)	3.3103*** (0.5025)	-0.0704 (0.2220)	-0.0468 (0.0568)	-2.0555*** (0.0427)	94.01	a	1.69

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

collinearity[1] but no evidence of auto-correlation in both formulations of Model 6.

On adding time to the set of explanatory variables, all the estimated coefficients, except that for the retail price of cocoa, increased in magnitude in the linear formulation.[2] In the logarithmic formulation,[3] with the exception of the population coefficient, all the estimated coefficients decreased in magnitude. Though the estimated sugar price coefficient is only significant at 5 percent, the sugar price variable[4] plays a major role in explaining

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[1] The simple correlation coefficient between the estimated total income and population coefficients, total income and time coefficients, total income and sugar price coefficients were 0.94, 0.96, and 0.93, respectively, in the linear formulation. In the logarithmic formulation, the simple correlation coefficient between the estimated total income and population coefficients, total income and time, and total income and sugar price coefficients were 0.98, 0.91, and 0.94, respectively.

[2] In the linear formulation, the estimated retail price of cocoa coefficient decreased from -0.0402 to -0.0476; the population coefficient increased from 0.0013 to 0.0058; the total income coefficient increased from 0.0000 to 0.0001; the sugar price coefficient increased from 1.7815 to 1.9383; and the soybean oil price coefficient increased from 0.3018 to 0.3166.

[3] In the logarithmic formulation, the estimated retail price of cocoa coefficient increased from -0.0318 to -0.0025; the population coefficient increased from 1.9325 to 3.2043; the total income coefficient decreased from -0.2997 to -0.4263; the sugar price coefficient decreased from 0.7587 to 0.6706; and the soybean oil price coefficient decreased from 0.2294 to 0.2218.

[4] Out of an R^2 of 90.28 percent in the linear formulation, the sugar price variable contributed 85.75 percent.

the variation in total consumption of cocoa for Canada.

When the model was tested on the United States data, the estimated retail price and time coefficients were of the expected signs in the linear formulation. The total income, population, sugar price, and soybean oil coefficients had signs opposite to those expected. In the logarithmic formulation only the estimated retail price of cocoa and population coefficients had the expected signs. The test for significance of the estimated coefficients indicated that, with the exception of the retail price of cocoa in the linear formulation, none of the other coefficients were significant. In the logarithmic formulation, the retail price of cocoa, population and time coefficients were highly significant while the total income, sugar price, and soybean oil price coefficients were not significant. The F-test indicated that the two formulations were highly significant. The Durbin-Watson test for auto-correlation was indeterminate for both formulations. In both forms, the estimated sugar price, population, and time coefficients were collinear.[1]

On adding time to the set of explanatory variables,

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[1] In the linear form the simple correlation coefficient between the estimated population and sugar price coefficients, the population and time coefficients, the sugar price and time coefficients were 0.91, 1.00, and 0.93, respectively. In the logarithmic form, the simple correlation coefficient between the estimated sugar price and population coefficients, population and time coefficients, retail price of cocoa and time coefficients were 0.92, 0.95, and 0.84, respectively.

the estimated retail price of cocoa and population coefficients increased in magnitude, the total income coefficient decreased in magnitude and the sugar price and soybean oil price coefficients not only decreased in magnitude but changed signs.[1]

Model 7

In Model 7 per capita consumption of cocoa was hypothesized as the dependent variable and the retail price of cocoa and per capita income were postulated as the independent variables. The results are presented in Table 7.

When the model was tested on the Canadian data, all the estimated coefficients in both the linear and logarithmic formulations were of the expected signs. However, the coefficients on the retail price of cocoa were not significant in either formulation while the per capita income coefficients were highly significant in both formulations. The R^2 in each case was low -- 38.25 percent for the linear formulation and 31.25 percent for the logarithmic formulation.

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[1] In the linear formulation, the estimated retail price of cocoa coefficient decreased from -2.5769 to -4.1281; the population coefficient decreased from 0.0056 to -0.0256; the total income coefficient increased from -0.0383 to -0.0306; the sugar price coefficient decreased from 4.5271 to -5.7671; and the soybean oil price coefficient decreased from 5.4522 to -2.4795. In the logarithmic formulation, the estimated retail price of cocoa coefficient increased from -0.1376 to -0.0969; the population coefficient increased from 1.0423 to 3.3103; the total income coefficient increased from -0.0112 to -0.0129; the sugar price coefficient decreased from 0.2075 to -0.0740; and the soybean oil price coefficient decreased from 0.0528 to -0.0468.

TABLE 7

RESULTS OF MODEL 7: DEMAND FOR NON-BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_2	Regression Coefficients b_8	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	2.5053	-0.0034 (0.0068)	0.0002*** (0.00006)	38.25	a	2.19
	Logarithmic	-0.0900	-0.0338 (0.0815)	0.1797*** (0.0634)	31.25	b	2.16
United States	Linear	3.8946	-0.0145*** (0.0059)	0.0001*** (0.00005)	42.22	a	1.00
	Logarithmic	0.4103	-0.1170** (0.0548)	0.0993** (0.0485)	35.96	b	0.08

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

For the United States data, all the estimated coefficients in both the linear and logarithmic formulations were of the correct signs. The estimated coefficients in the linear formulation were highly significant but this formulation had a low R^2 of 42.22 percent. In the logarithmic formulation the estimated retail price of cocoa and per capita income coefficients and the equation itself had a lower level of significance. The R^2 in the logarithmic formulation was 35.96 percent. It may be concluded that in both Canada and the United States, retail price and per capita income do not adequately explain the variations in the per capita consumption of cocoa.

Tables 8 and 9 summarize the various elasticities -- own-price, income, and cross-price -- and price flexibilities obtained from the various models which were postulated to explain the variation in the total and per capita consumption of cocoa in Canada and the United States from 1950 to 1972.

Own-Price Elasticities of Demand for Cocoa in Its Non-Beverage Uses

For Canada, all the own-price elasticities obtained in analysis had the expected signs that is, they were negative. The own-price elasticities ranged from $^{-}0.2643$ to $^{-}0.0025$. None of the calculated elasticities, except the one in the logarithmic equation of Model 2, were significant at the 10 percent level. The elasticity coefficient

TABLE 8

SUMMARY OF THE ESTIMATED ELASTICITIES FOR THE NON-BEVERAGE USE OF COCOA FOR CANADA

Model Form	Model Number	Price Elasticity	Price Flexibility	Income Elasticity	Cross-Price Elasticity With Respect to Sugar Prices	Cross-Price Elasticity With Respect to Soybean Oil Prices
Linear	2	-0.2304	-4.3403			
	3	-0.1051	-9.5147	0.3980		
	4	-0.0772	-12.9534	0.3980	0.7142	0.1850
	5	-0.0529	-18.9036	0.0001	0.7771	0.1941
	6	-0.0626	-15.9744	0.1990		
	7	-0.0045	-222.2222	0.3980		
Logarithmic	2	-0.2643**	-3.7836			
	3	-0.0797	-12.5471	0.4093***		
	4	-0.0543	-18.4162	0.2791		
	5	-0.0318	-31.4465	-0.2997	0.7597**	0.2294*
	6	-0.0025	-400.0000	-0.4263	0.6706**	0.2218**
	7	-0.0338	-29.5858	0.1797***		

*** ** * Refer to Table 1.

TABLE 9

SUMMARY OF THE ESTIMATED ELASTICITIES FOR THE NON-BEVERAGE USE OF COCOA FOR THE UNITED STATES

Model Form	Model Number	Price Elasticity	Price Flexibility	Income Elasticity	Cross-Price Elasticity With Respect to Sugar Prices	Cross-Price Elasticity With Respect to Soybean Oil Prices
Linear	2	-0.2523	-3.9635			
	3	-0.2088	-4.7893	0.1448		
	4	-0.0975	-10.2564	-0.0418		
	5	-0.1188	-8.4175	-0.0251	0.0633	0.1172
	6	-0.1904	-5.2521	-0.0200	-0.0807	-0.0533
	7	-0.0007	-1428.5714	83.4823		
Logarithmic	2	-0.2723**	-3.6724			
	3	-0.2856***	-3.5014	-0.0249		
	4	-0.1216**	-8.2237	-0.0177		
	5	-0.1376**	-7.2674	-0.0112	0.2075	0.0528
	6	-0.0969***	-10.3199	0.0129*	-0.0704	-0.0468
	7	-0.1170**	-8.5470	0.0993**.		

*** ** * Refer to Table 1.

in the logarithmic equation of Model 2 was significant at the 5 percent level but its contribution to R^2 was only 9.87 percent. The demand function for cocoa is clearly price inelastic.

The elasticity coefficients for the United States data were not significant at 10 percent in the linear formulations of the models. In the logarithmic equations, the coefficients in Models 2, 4, and 7 were significant at 5 percent, and those in Models 3 and 6 were significant at 1 percent. However, the contribution of the retail price variable to R^2 in all the formulations was low.[1] The calculated price elasticities ranged from $^{-}0.2856$ to $^{-}0.1170$. The analysis indicated that although the retail price elasticity coefficients carried the correct signs, they did not explain an appreciable proportion of the variation in the total consumption of cocoa.

Income Elasticities of Demand for Cocoa in Its Non-Beverage Uses

The results indicated that all the elasticity coefficients obtained in the linear equations were not significant at 10 percent. In the logarithmic formulations, Models 3 and 7 gave income elasticity coefficients which were significant at 1 percent. The coefficients in Models 4, 5, and 6 were not significant at the 10 percent level in Canada.

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[1] The highest contribution by the cocoa retail price variable was 24.85 percent in Model 7.

The calculated income elasticities ranged from ⁻0.4263 to 0.4093 in the logarithmic equations, and 0.0001 to 0.3980 in the linear equations. Considering the signs and magnitudes of the elasticity coefficients which were significant, the demand function for cocoa is income inelastic and cocoa may be considered a normal good.

In the absence of the explanatory variable of sugar price,[1] the income variable appears to play a major role in explaining the variation in the total consumption of cocoa in Canada. On the otherhand, the per capita income variable[2] explained only a small portion of the variation in per capita consumption of cocoa.

For the United States, the calculated income elasticities ranged from ⁻0.0249 to 83.4823. It was only in the logarithmic form of Model 7 that the estimated per capita income was significant at the 5 percent level. However, in this form, the per capita income variable explained only 13.43 percent of the variation in the per capita consumption of cocoa. One may conclude that both total and per capita income appear not to explain a substantial portion

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[1] In the absence of the sugar price variable, the income variable contributed 84.90 percent to the R^2 in the linear form of Model 3. When the sugar price variable was added to the set of explanatory variables, this partial contribution dropped to 2.45 percent in the linear form of Model 5.

[2] The per capita income variable explained only 37.51 percent of the variation in per capita consumption of cocoa for the linear form of Model 7.

of the variation in the total consumption and per capita consumption of cocoa, respectively.

Cross-Price Elasticities of Demand for Cocoa with Respect to Sugar Prices

For Canada, the calculated cross-price elasticities were 0.7142 and 0.7771 for the linear forms of Models 5 and 6, and 0.7597 and 0.6706 for the logarithmic forms. The coefficients in the linear equations were not significant but those in the logarithmic equation were significant at the 5 percent level. The cross-price elasticities bore positive signs which implied that sugar was a substitute for cocoa. In practical terms it is not entirely plausible that cocoa and sugar are substitutes from the manufacturers' point of view. A substitute relationship in manufacturing would mean that by using either cocoa or sugar one could make, say, chocolate. These inputs are complements up to a point, and beyond this they become partial substitutes. However, in terms of consumption of the final product, there are non-chocolate substitutes which also use sugar. A substitute relationship arising here from cocoa and sugar is not anomalous. In conclusion, the results obtained indicate that sugar and cocoa are related and that sugar prices[1] appear to play a significant role in explaining the

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[1] For example, in the linear form of Model 5, the sugar price variable contributed 85.75 percent to the R^2.

variation in the total consumption of cocoa in Canada.

For the United States, when time was included as an explanatory variable, the sugar price coefficients in both the linear and logarithmic formulations had negative signs, which implied complementarity between cocoa and sugar. The estimated coefficients of 0.0633 and ¯0.0807 in the linear forms of Models 5 and 6 and 0.2075 and ¯0.0704 in the logarithmic forms were not significant at 10 percent. The low significance of the sugar price coefficient, when sugar price and time were included in the explanatory variables, might be attributed in part to problems of multi-collinearity, as the time-sugar price correlation coefficient was 0.93. But this did not eliminate the fact that the estimated sugar price coefficient remained insignificant when time was excluded from the regressions, that is, in Model 5. Sugar prices,[1] therefore, do not appear to play a significant role in explaining the variation in the total consumption of cocoa in the United States.

Cross-Price Elasticities of Demand for Cocoa with Respect to Soybean Oil Prices

For Canada, the estimated soybean oil price coefficient had the expected positive sign implying that cocoa and soybean oil are substitutes. However, the coefficients were not significant at 10 percent in the linear forms of

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[1] The sugar price variable contributed 0.06 percent to the R^2 in the linear form of Model 5.

Models 5 and 6, and it contributed only 0.08 percent to the R^2, 1.16 percent in the linear form of Model 6 and 0.06 percent in the logarithmic form of Model 6.

Though the soybean oil price coefficients had positive signs, soybean oil prices explain a small proportion of the variation in the total consumption of cocoa.

For the United States, when the time variable was included as an explanatory variable, the sign of the estimated soybean oil price coefficient became negative, implying complementarity between cocoa and soybean oil. However, the estimated soybean oil price coefficients in either formulation were not significant at the 10 percent level. The soybean oil price coefficient contributed 2.90 percent to the R^2 in Model 5 and 0.16 percent in Model 6. In conclusion, soybean oil prices do not play a significant role in explaining the variation in the total consumption of cocoa in the United States in the model specifications based on this particular set of observations.

Results and Discussion: Demand for the Beverage Uses of Cocoa

Model 1

In this model it was postulated that total consumption of cocoa was dependent on the wholesale prices of cocoa, coffee, and tea. The validity of this postulation was tested on both the Canadian and the United States data, as

TABLE 10

RESULTS OF MODEL 1: DEMAND FOR BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_9	b_{10}	b_{11}	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	41.2343	-0.0198 (0.1619)	-0.1724 (0.1371)	-0.1549 (0.1884)	19.57	d	0.55
	Logarithmic	2.6272	-0.0840 (0.2030)	-0.3732 (0.2574)	-0.2944* (0.3897)	22.73	d	0.61
United States	Linear	1245.7048	-2.0884 (2.7023)	-2.9215 (2.2915)	-6.6542** (3.1453)	42.26	b	0.61
	Logarithmic	4.3227	-0.1506 (0.1165)	-0.2034* (0.1477)	-0.5390** (0.2236)	47.11	a	0.61

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

was the case for all models. The results are presented in Table 10.

For Canada, with the exception of the estimated wholesale price of cocoa coefficient, all the other coefficients were negative, which is opposite to that expected. None of the coefficients, except the tea price coefficient in the logarithmic formulation, were significant at the 10 percent level. Auto-correlation occurred in both formulations.

It may be concluded that Model 1 is not significant, implying that the estimated wholesale prices of cocoa, coffee, and tea do not explain a significant proportion of the variations in the total consumption of cocoa. The results may have been affected by the auto-correlation occurring in the two formulations.

Similar results occurred when the model was tested using the United States data. The estimated wholesale price of cocoa coefficient was of the expected negative sign while the coefficients for the wholesale prices of coffee and tea had opposite signs to those expected in both formulations of Model 1. The estimated wholesale price coefficients of cocoa and coffee were not significant at 5 percent while the estimated coefficient for the wholesale price of tea was significant at 5 percent. The R^2 was 42.26 percent in the linear formulation and 47.11 percent in the logarithmic formulation. Positive auto-correlation occurred in both formulations. In conclusion, the non-significant coefficients may be due to the presence of

auto-correlation.

Model 2

Model 2 states that total consumption of cocoa is dependent on the wholesale prices of cocoa, coffee, and tea, and total income. The results are presented in Table 11.

When the model was tested on the Canadian data, all the estimated coefficients had signs opposite to those expected in both the linear formulation and in the logarithmic formulation. Only the estimated income and tea coefficients were significant at 1 percent. The F-test indicated the two formulations were significant at the 1 percent level. The Durbin-Watson test for auto-correlation in the two formulations of Model 2 was indeterminate. On adding total income to the explanatory variables, there were increases in the values of all the estimated coefficients.[1] Based on these results, the income variable[2] seems to be the most important factor explaining the variation in the total consumption of cocoa in Canada.

For the United States, the estimated total income and wholesale price of cocoa coefficients were of the expected

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[1] For example, in the linear formulation, the estimated cocoa price coefficient increased from -0.0198 to 0.0673; the coffee price coefficient increased from -0.1724 to -0.0386; and the tea price coefficient increased from -0.1549 to 0.0981.

[2] The income variable contributed 84.90 percent to the R^2 of 87.73 percent in the linear formulation and 91.21 percent in the logarithmic formulation.

TABLE 11

RESULTS OF MODEL 2: DEMAND FOR BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients				R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
			b_3	b_9	b_{10}	b_{11}			
Canada	Linear	13,0908	-0.0002*** (0.0000)	-0.0673 (0.0651)	-0.0386 (0.0567)	-0.0981*** (0.0797)	87.73	a	2.43
	Logarithmic	-0.5556	0.4118*** (0.0525)	-0.0609 (0.0993)	-0.0552 (0.1322)	-0.1203 (0.1977)	82.51	a	2.26
United States	Linear	1087.7851	0.1358 (0.1053)	-2.5768 (2.6734)	-1.8778 (2.3935)	-5.5169* (3.2152)	47.14	b	0.83
	Logarithmic	4.5106	-0.0353** (0.0195)	-0.1490* (0.1101)	-2.2500** (0.1419)	-0.5526*** (0.2114)	55.27	a	0.66

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

signs while the wholesale price of coffee and tea coefficients had negative signs, which were opposite to those expected. The estimated coefficients for the total income and the wholesale price of cocoa and coffee variables were not significant at 5 percent while the wholesale price of tea was significant at 5 percent in the linear formulation. In the logarithmic formulation, the estimated wholesale price of cocoa coefficient was significant at 10 percent, the total income and wholesale price of coffee coefficients were significant at 5 percent, and the estimated wholesale price of tea coefficient was significant at the 1 percent level. In terms of the R^2, the linear and logarithmic formulations explained 47.14 percent and 55.27 percent of the total consumption of cocoa in the United States. The Durbin-Watson test for auto-correlation indicated that there was positive auto-correlation in both formulations of Model 2.

On adding total income to the set of explanatory variables, the estimated wholesale price of tea coefficient became significant at 1 percent. However, the coefficients for the wholesale price of cocoa and coffee variables were still not significant. In the linear formulation,[1] there were increases in the values of the coefficients for the

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[1] The wholesale price of cocoa coefficient decreased from -2.0884 to -2.5768; the wholesale price of coffee coefficient increased from -2.9215 to -1.8778; and the wholesale price of tea coefficient increased from -6.6542 to -5.5169.

wholesale price of coffee and tea variables and a decrease in the wholesale price of cocoa coefficient. In the logarithmic formulation,[1] there was an increase in the value of the coefficient for the wholesale price of cocoa variable and decreases in the estimated wholesale price of coffee and tea coefficients occurred.

Model 3

In Model 3, total consumption of cocoa was postulated as the dependent variable. Total income, population, and the wholesale prices of cocoa, coffee, and tea were hypothesized as the independent variables. The results are given in Table 12.

For Canada, all the estimated coefficients, except the total income and wholesale price of cocoa coefficients, had signs opposite to those expected in both the linear and logarithmic formulations. In terms of their significance, only the total income coefficient in the linear formulation was significant at the 1 percent level. All the other coefficients were not significant at the 10 percent level. The R^2 for the linear formulation was 87.73 percent and 82.52 percent for the logarithmic formulation. The presence of high levels of the R^2 while the coefficients are not

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[1] The Whoelsale price of cocoa coefficient increased from -0.1506 to -0.1490; the wholesale price of coffee coefficient decreased from -0.2034 to -0.2500; and the wholesale price of tea coefficient decreased from -0.5390 to -0.5526.

TABLE 12

RESULTS OF MODEL 3: DEMAND FOR BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_3	b_4	b_9	b_{10}	b_{11}	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	13.2685	0.0002*** (0.0000)	-0.0000 (0.0008)	-0.0675 (0.0684)	-0.0394 (0.0742)	-0.0988 (0.0939)	87.73	a	2.43
	Logarithmic	-0.4736	0.4197 (0.4188)	-0.0280 (1.4777)	-0.0615 (0.1081)	-0.0579 (0.1965)	-0.1240 (0.2789)	82.52	a	2.26
United States	Linear	32.9269	-0.1062** (0.0581)	0.0055*** (0.0007)	1.7523* (1.2634)	0.6759 (1.1725)	-5.2686*** (1.5158)	88.91	a	1.04
	Logarithmic	-2.1516	-0.0211*** (0.0103)	1.1215*** (0.1599)	-0.1127** (0.0575)	0.0000 (0.0819)	-0.4130*** (0.1118)	88.56	a	1.12

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

significant is evidence of multi-collinearity.[1]

When the model was tested on the United States data, the results indicated that with the exception of the wholesale price of coffee coefficient, all the other coefficients had signs opposite to those expected. In terms of the variation in total consumption of cocoa which was explained by the model, the R^2 for the linear formulation was 88.91 percent and 88.56 percent for the logarithmic formulation. The Durbin-Watson test for auto-correlation indicated that there was positive auto-correlation in both formulations of Model 3. In the United States, the population variable[2] appears to be the most important variable explaining the variation in the total consumption of cocoa.

Model 4

In this model it was postulated that total consumption of cocoa was dependent on the wholesale prices of cocoa, coffee, and tea, total income, population, and time. The results are presented in Table 13.

For Canada, the signs of the estimated wholesale prices of cocoa and tea, income, and time coefficients were as expected while the population and the wholesale price of coffee coefficients were of the opposite sign in the linear

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[1] The simple correlation coefficient between the estimated total income and population coefficients was 0.94.

[2] The R^2 for the linear formulation is 88.91 percent and the population variable contributed 77.67 percent.

TABLE 13

RESULTS OF MODEL 4: DEMAND FOR BEVERAGE USE OF COCOA

Country	Model Form	Intercept	Regression Coefficients b_3	b_4	b_7	b_9	b_{10}	b_{11}	R^2 (%)	Significance of the Equation	Durbin-Watson Statistic
Canada	Linear	113.0947	0.0001 (0.0002)	-0.0073 (0.0113)	3.2934 (5.0481)	-0.0473 (0.0761)	-0.0679 (0.0872)	0.1125 (0.0978)	88.05	a	2.58
	Logarithmic	-8.5513	0.0805 (0.4438)	2.2384 (1.9287)	-0.1941** (0.1136)	-0.0372 (0.1035)	0.0554 (0.1977)	0.1113 (0.2645)	85.22	a	2.29
United States	Linear	2043.1547	-0.0818 (0.0623)	-0.0078 (0.0125)	34.2542 (32.1758)	-2.3967** (1.3965)	-0.1117 (1.3825)	-4.1296** (1.8505)	89.64	a	1.10
	Logarithmic	-10.6823	-0.0130** (0.0063)	2.7199*** (0.2997)	-0.1939*** (0.0345)	-0.1074*** (0.0344)	0.0050 (0.0490)	-0.2396*** (0.0736	96.15	a	1.73

*** ** * Refer to Table 1.

a,b,c,d Refer to Table 1.

formulation. In the logarithmic formulation, with the exception of the estimated time coefficient, all the estimated coefficients were of the expected signs. With the exception of the time coefficient, none of the other coefficients were significant at the 10 percent level. The Durbin-Watson test for auto-correlation for the two formulations was indeterminate. There is multi-collinearity[1] in both formulations.

On adding time to the set of explanatory variables, the values of the estimated wholesale price of coffee, the wholesale price of tea, and population coefficients decreased but the values of the estimated total income and wholesale price of cocoa coefficients increased in the linear formulation.[2] In the logarithmic formulation,[3] with the exception

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[1] For example, in the linear formulation, the estimated total income, population, and time coefficients were collinear. The simple correlation coefficient between the estimated population and total income coefficients, the population and time coefficients, and the total income and time coefficients were 0.94, 1.00, and 0.96, respectively.

[2] The estimated total income coefficient decreased from 0.0002 to zero; the population coefficient decreased from zero to -0.0073; the wholesale price of cocoa coefficient increased from -0.0675 to -0.0473; the wholesale price of coffee coefficient decreased from -0.0394 to -0.0679; and the wholesale price of the coefficient increased from 0.0988 to 0.1125.

[3] The estimated total income coefficient decreased from 0.4197 to 0.0805; the population coefficient increased from -0.0280 to 2.2384; the wholesale price of cocoa coefficient increased from -0.0615 to -0.0372; the wholesale price of coffee coefficient increased from -0.0579 to 0.0554; and the wholesale price of tea coefficient decreased from 0.1240 to 0.1113.

of the estimated wholesale price of tea coefficient, all the estimated coefficients increased in value. Also, the sign of the estimated population coefficient changed to the expected positive sign and the sign of the wholesale price of coffee coefficient became negative. In Canada, the estimated total income coefficient[1] is the most important variable explaining the variation in the total consumption of cocoa, based on the results of this analysis.

When the model was tested on the United States data, only the estimated time and wholesale price of cocoa coefficients were of the expected signs. All the other coefficients had signs opposite to those expected in the linear formulation. In the logarithmic formulation, the population and wholesale price of cocoa and coffee coefficients had the expected signs while the coefficients for total income, time, and the wholesale price of tea variables had signs opposite to those expected. In the linear formulation, the wholesale price of cocoa and tea coefficients were significant at 5 percent while the other coefficients were not significant at 10 percent. In the logarithmic formulation, the income coefficient was significant at the 5 percent level, the wholesale price of coffee coefficient was not significant at 10 percent and the popu-

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[1] The estimated total income coefficient contributes 84.90 percent to the R^2 of 88.05 percent in the linear formulation of the model.

lation, time, wholesale price of cocoa and tea coefficients were significant at 1 percent.

The R^2 for the linear and the logarithmic formulations were 89.64 percent and 96.15 percent, respectively. The Durbin-Watson test for auto-correlation in both forms of Model 4 was indeterminate. The test for multi-collinearity indicated that the population and time coefficients were collinear.[1]

When the time variable was added to the set of explanatory variables, the estimated total income and wholesale price of tea coefficients increased in value and the population, wholesale price of cocoa and tea coefficients decreased in value in the linear formulation.[2] Also the signs of the estimated population and wholesale price of coffee coefficients became negative. In the logarithmic formulation,[3] all the estimated coefficients increased in value.

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[1] The simple correlation coefficient between the estimated population and time coefficients was 0.95.

[2] The value of the estimated total income coefficient increased from -0.1062 to -0.0818; the population coefficient decreased from 0.0055 to -0.0078; the wholesale price of cocoa coefficient decreased from -1.7523 to -2.3967; the wholesale price of coffee coefficient decreased from 0.6759 to -0.1117 and the wholesale price of tea coefficient increased from -5.2686 to -4.1296.

[3] The estimated total income coefficient increased from -0.0211 to -0.0130; the population coefficient increased from 1.1251 to 2.7199; the wholesale price of cocoa coefficient increased from -0.1127 to -0.1074; the wholesale price of coffee coefficient increased from zero to 0.0050; and the wholesale price of tea coefficient increased from -0.4130 to -0.2396.

The results of the estimated elasticities -- own-price, income, and cross-price with respect to coffee and tea prices -- of demand for the beverage use of cocoa are presented in Table 14 for Canada and in Table 15 for the United States. The statistical significance of the coefficients on which these results are based was tested by using the T-test. A discussion of these results follows.

Own-Price Elasticities of Demand for Cocoa in Its Beverage Use

The signs of the coefficients on the own-price variable, and thus the signs of the estimates of the elasticity of demand for cocoa with respect to the wholesale price of cocoa, were negative (as expected) for both Canada and the United States. None of the coefficients on the price variable which were estimated for Canada were significant at the 10 percent level. For the United States, none of the estimated coefficients on the price variable in the linear formulations were significant at the 10 percent level. In the logarithmic formulations of the four models, the estimated coefficient on the wholesale price of cocoa variable was not significant at the 10 percent level in the first equation, and was significant at the 10 percent level in the second equation. This coefficient was also significant at the 5 and 10 percent levels, respectively, in the logarithmic forms of Models 3 and 4. However, the contribution to the R^2 by this variable, even when it had significant

coefficients, were low. The wholesale price of cocoa variable accounted for only 4.56 percent in the variation of total consumption of cocoa in the logarithmic form of Model 2, 2.46 percent in the logarithmic form of Model 3, and 2.53 percent in the logarithmic form of Model 4. The magnitudes of the estimated coefficients indicate that the demand function for cocoa in its beverage use is price inelastic for the United States.

Income Elasticities of Demand for Cocoa in Its Beverage Uses

For Canada, the signs of the estimated coefficients on the total income variable, except for the coefficient in the linear form of Model 2, were positive as expected. Only the coefficient in the logarithmic form of Model 2 was significant at the 1 percent level, the other estimates were not significant at the 10 percent level. This significant coefficient explained 81.21 percent of the variation in the total consumption of cocoa. The magnitude of the significant income elasticity indicates that cocoa is an income inelastic normal good.

For the United States, the estimated coefficients on the total income variable,except in the case of the linear form of Model 2, were negative and thus opposite to those expected. None of the coefficients in the linear formulations were significant at the 10 percent level. In the logarithmic formulations, the estimated coefficients in Models 2, 3, and 4 were significant at the 10 percent level.

TABLE 14

SUMMARY OF THE ESTIMATED ELASTICITIES FOR THE BEVERAGE USE OF COCOA IN CANADA

Model Form	Model Number	Price Elasticity	Price Flexibility	Income Elasticity	Cross-Price Elasticity With Respect to Coffee Prices	Cross-Price Elasticity With Respect to Tea Prices
Linear	1	-0.0261	-38.3142	--	-0.3356	-0.3356
	2	-0.0886	-11.2867	-0.3980	0.0886	0.2073
	3	-0.0889	-11.2486	0.3980	-0.0767	0.2088
	4	-0.0623	-16.0514	0.1990	-0.1322	0.2377
Logarithmic	1	-0.0840	-11.9048	--	-0.3712*	-0.2944
	2	-0.0609	-16.4204	0.4118***	0.0552	0.1203
	3	-0.0615	-16.2602	0.4197	-0.0579	0.1240
	4	-0.0372	-26.8817	0.0805	0.0554	0.1113

*** Refer to Table 1.

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AN ANALYSIS OF THE DEMAND FOR COCOA IN CANADA AND IN THE...

TABLE 15

SUMMARY OF THE ESTIMATED ELASTICITIES FOR THE BEVERAGE USE OF COCOA IN THE UNITED STATES

Model Form	Model Number	Price Elasticity	Price Flexibility	Income Elasticity	Cross-Price Elasticity With Respect to Coffee Prices	Cross-Price Elasticity With Respect to Tea Prices
Linear	1	-0.0959	-10.4275	--	-0.1992	-0.4931
	2	-0.1183	-8.4531	0.0890	-0.1281	-0.4088
	3	-0.0804	-12.4378	-0.0696	-0.0461	-0.3904
	4	-0.1100	-9.0909	-0.0536	-0.0076	-0.3060
Logarithmic	1	-0.1506	-6.6401	--	-0.2034*	-0.5390**
	2	-0.1490*	-6.7114	-0.0353**	-0.2500**	-0.5526***
	3	-0.1127**	-8.8731	-0.0211**	0.0001	-0.4130***
	4	-0.1074**	-9.3110	-0.0130**	0.0050	-0.2396***

*** ** * Refer to Table 1.

The contribution by the total income variable to the R^2 in the logarithmic forms of Models 2, 3, and 4 were 8.26 percent, 2.98 percent, and 1.09 percent, respectively. Thus the total income variable appears to explain only a small portion of the variation in total consumption of cocoa. The magnitudes of the calculated income elasticities suggest that cocoa is an income inelastic inferior good. The difference in the signs of the significant estimates of the income elasticity of demand for Canada compared to the United States cannot be easily explained. A probable explanation as to why the consumption of cocoa is negatively affected by income increases in the United States is that people's tastes and preferences for cocoa move against cocoa consumption so that as their incomes rise, they tend to consume less cocoa. Nonetheless, published data show that the per capita consumption of cocoa is higher in the United States than in Canada.

Cross-Price Elasticities of Demand for the Beverage Use of Cocoa with Respect to Coffee Prices

For Canada, only the estimated coefficient on the price of coffee variable in the logarithmic form of Model 1 was significant at the 10 percent level. The sign of this coefficient indicates that cocoa and coffee are complementary goods. This coefficient explained 19.71 percent of the variation in the total consumption of cocoa.

For the United States, only the estimated coefficients

in the logarithmic equations of Models 1 and 2 were significant at the 10 and 5 percent levels, respectively. The signs on these coefficients were negative, implying a complementary relationship between cocoa and coffee but this relationship does not appear to be strong. The feature of complementarity may suggest that people who drink cocoa also tend to be coffee drinkers, and this may also be the case for Canada.

Cross-Price Elasticities of Demand for the Beverage Use of Cocoa with Respect to Tea Prices

The results from the analysis of the Canadian data indicated that none of the estimated coefficients on the tea price variable were significant at the 10 percent level. Again, none of these coefficients for the linear equations for the United States was significant at the 10 percent level. On the other hand, all these coefficients from the logarithmic formulations were significant, though they all carried negative signs (which were opposite to the expected signs). The contribution to R^2 by the tea price variable in the logarithmic formulations was relatively low -- 16.08 percent in the logarithmic forms of Models 1 and 2, 8.73 percent in the logarithmic form of Model 3, and 2.05 percent in the logarithmic equation of Model 4. The negative signs of the estimated coefficients suggest that tea and cocoa are complementary goods. A possible explanation for the apparent complementarity occurring between cocoa and tea in

the United States is that people who drink beverages such as coffee or tea tend also to drink cocoa.

This chapter has presented the results of the statistical analysis of the demand for both the non-beverage and beverage uses of cocoa in Canada and the United States from 1950 to 1972. The concluding section of this chapter provides a discussion of the implications of these results.

Implications of the Results

Own-Price Elasticities of Demand for Cocoa in Its Beverage and Non-Beverage Uses

The own-price elasticity of demand for cocoa in both its uses as a beverage and as a non-beverage was found to be inelastic. Thus, a fall in the price of cocoa, other things being equal, would result in a proportionately smaller increase in total consumption of cocoa. In other words, everything else being equal, a relatively small change in market supplies will, when the demand for a commodity is inelastic, lead to relatively large fluctuations in prices. This feature is evident in the prices of cocoa for the period 1950 to 1972. Thus, cocoa is susceptible to market instability and this situation is likely to continue into the future so long as the supplies of cocoa are markedly unstable.

Income Elasticities of Demand of Cocoa in Its Beverage and Non-Beverage Uses

The majority of the estimated income coefficients for Canada were not significant at the 10 percent level. In the three instances of significant coefficients, the indication was that cocoa was a normal good in both its beverage and non-beverage uses. For the United States, the coefficients which were significant indicated that cocoa was an inferior good in its beverage use and a normal good in its non-beverage use.

In the case of Canada, the income elasticity was less than one; thus, an increase in income would be expected to yield a less than proportionate increase in the total consumption of cocoa in both uses. Thus, income increases are unlikely to generate a substantial shift in the aggregate market demand function for cocoa in Canada. In the United States, an increase in income seems likely to lead to an actual fall in the consumption of beverage cocoa and to a less than proportionate increase in the total consumption of cocoa in its non-beverage uses. Nonetheless, the analysis indicated that income has been the most important factor affecting the demand for the beverage and non-beverage uses of cocoa in Canada and the demand for beverage use in the United States for the period under study. Income may continue to play this role in future. However, the low and even negative income elasticity results pose problems for the cocoa exporting developing countries since increases in

consumption of cocoa resulting from higher incomes are likely to be relatively small or even negative.

The low values of the own-price and income elasticities for Canada and particularly for the United States present a serious problem to the producing countries in light of the rapid development and spread of technology which has tended to stabilize and increase the supply of cocoa. The presence of an inelastic demand function for cocoa implies that producers may, as a group, increase their total revenue by withholding supplies and thus increasing prices. The implication of this type of group action are discussed in the final chapter.

The low values of the estimates of the cross-price elasticities of demand suggest that cocoa does not have close substitutes. In the non-beverage use of cocoa, sugar and vegetable oils are the most likely substitutes for cocoa at the processing level. At the consumption level, non-chocolate and non-cocoa candies and cookies are the likely close substitutes. For the beverage uses of cocoa, coffee, tea and soft drinks appear to be the likely close substitutes.

Cross-Price Elasticities of Demand for Cocoa with Respect to Sugar Prices

Regarding the relationship between cocoa and sugar, as was previously noted, it is difficult to define the exact type of relationship existing between cocoa and sugar, especially from the manufacturing point of view. When we

consider that other non-cocoa products which are alternatives to cocoa products also use sugar, the substitute relationship existing between cocoa and sugar as suggested by this analysis may not be anomalous.

Cross-Price Elasticities of Demand for Cocoa with Respect to Soybean Oil Prices

For the United States, none of the estimated coefficients for the soybean oil price variable were significant at the 10 percent level.

The analysis using the Canadian data indicated that the coefficients were of the positive signs and that these coefficients were significant at the 5 percent level in the logarithmic formulations. One implication of this result is that higher prices of cocoa may result in a substantial substitution of soybean oil for cocoa butter. Shisko[1] reports that when the prices of cocoa are high, manufacturers use certain vegetable fats or dairy butter as a substitute for cocoa butter in the manufacture of compound coatings.

Cross-Price Elasticities of Demand for Cocoa in Its Beverage Use with Respect to Coffee Prices

For both Canada and the United States, the signs of the coefficients which were significant indicate that cocoa

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[1] I. Shisko, "How to Forecast Cocoa Prices," Guide to Commodity Price Forecasting (New York: Commodity Research Bureau, Inc., May, 1971), p. 102.

and coffee are complements. This feature may suggest that people who drink coffee tend to be cocoa drinkers.

Cross-Price Elasticities of the Demand for the Beverage Use of Cocoa with Respect to Tea Prices

None of the estimated coefficients on the tea price variable for Canada and for the linear equations of Models 1 to 4 for the United States were significant at the 10 percent level. The coefficients for the logarithmic formulations for the United States were highly significant. These coefficients bore signs opposite to those expected and indicate that tea bears a complementary relationship to cocoa.

The calculated values of the cross-price elasticities of demand for cocoa with respect to coffee and tea prices were relatively low. These low values suggest that changes in the prices of coffee and tea would appear to have a limited effect on the demand function for beverage cocoa. Consumers' desire for variety in their beverages may be a possible explanation of the relatively low cross-price elasticity values.

Limitations of the Study

The use of annual average data in the analysis poses certain problems. The use of average annual data may obscure variations in the variables during the year and thus may obscure or bias the results. Various other problems were posed by the availability of data. There were no data

on the stocks of cocoa or on the prices of the final products of cocoa. Data on the retail prices of cocoa and sugar were lacking for Canada. Again, for Canada, there were no data on the wholesale prices of raw coffee and tea. There were no separate data for the consumption of cocoa as a beverage or for the consumption of cocoa as a non-beverage. This particular feature places limitations on the analysis of the beverage and non-beverage uses of cocoa. Another major problem of the study lies in the behavioural assumptions implicit in the use of single-equation models. An attempt was made to develop a simultaneous equation model but statistical problems and the limitations of available data for the study did not allow for successful completion of this. A further statistical problem evident in regression analysis concerns the direction of causality in the single-equation models. The results of the analysis suggest that a relationship applies, but cannot confirm, the direction of causality. The results also apply only to the model specifications based on the data and for the period under study. The results cannot be applied to other time periods. There were no simple solutions to the problems of auto-correlation and multi-collinearity.

CHAPTER V

IMPLICATIONS OF THE RESULTS FOR A COMMODITY AGREEMENT, RECOMMENDATIONS, AND SUMMARY

Introduction

A number of the producing countries in Latin America use most of the cocoa they grow.[1] However, the majority of the cocoa producing countries, especially those in West Africa, depend on cocoa exports for a major portion of their exchange earnings. The prices of cocoa and, therefore, the level of foreign exchange earnings of these countries have been subject to much fluctuation. The extent of price fluctuations depends, at least partly, upon the nature of the demand function for the commodity. Information on the own-price elasticity of demand and on the income and cross-price elasticities of demand for cocoa may be useful in determining whether a commodity agreement would benefit producers.

Implications for a Commodity Agreement

The results of this study indicate that the demand

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[1] V.D. Wickizer, Coffee, Tea, and Cocoa: An Economic and Political Analysis (Stanford, California: Stanford University Press, April, 1951), p. 266.

functions for both the beverage and the non-beverage uses of cocoa are price and income inelastic for both Canada and the United States. For Canada, cocoa is a normal good in both its uses as a beverage and as a non-beverage. For the United States, cocoa is a normal good in its non-beverage use while it is an inferior good in its beverage uses. When supplies are confronted by a price inelastic demand function, relatively small changes in supplies are likely to lead to price fluctuations. The low values of the estimated income elasticities suggest a slow future growth in the demand for the beverage and the non-beverage uses of cocoa in Canada. This slow growth in demand is likely also for the non-beverage use of cocoa in the United States. The beverage use of cocoa in the United States is likely to fall as income increases.

In light of these results and also the fact that earnings from cocoa exports are important to the economies of a number of the developing countries, the author favours a commodity agreement on cocoa in which floor and ceiling prices are agreed upon by the contracting parties. The agreement would benefit the producing countries. The prices of cocoa and the total revenue to cocoa producers could be increased if production or export quotas limiting expansion in market supplies were applied. If such an agreement operated, producers could have a more certain basis for planning operations within the cocoa industry. A commodity agreement which incorporates purchasing agreements might

contribute to price stability at both the producer and exporter levels.

The operation of any agreement should be generally along the lines envisaged in the International Cocoa Agreement[1] which came into force on 30 April 1973. This Agreement was briefly discussed in Chapter III. However, there is a strong case for arguing that unlike the present Agreement the allocation of national export quotas should be made on the basis ofthe importance of cocoa to each exporting country's economy. In practice, such quotas have been applied on the basis of the past levels of each country's annual production. This does not seem to be the most equitable method of quota allocation. For instance, earnings from exports of oil are now the leading foreign exchange source for Nigeria, but since Nigeria is the second leading producer of cocoa, it has been allocated the second highest cocoa export quota. The equity of this allocation can be questioned. The allocation of quotas on the basis of the relative importance of cocoa to each country would, however, be difficult. The relative importance of any crop to a country's economy is difficult to determine. Opposition could be expected from the leading producers and exporters.

Another problem which arises in any international commodity agreement is that it is difficult for both the

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[1] International Cocoa Agreement (Wellington, New Zealand: Government Printer, 1975).

producing and importing countries to agree on the floor and ceiling prices. This problem has applied in the cocoa market in the past.[1] Producing countries who depend on cocoa exports for their foreign exchange earnings would like to have reasonably high support prices that will enable them to increase their earnings from cocoa. The importing countries would, on the other hand, likely prefer to regard such a scheme as insurance against very low prices being paid to the producing countries. Any agreement which led to increased and more stable price levels would attract new producers thus making it very difficult to maintain the program unless a quota program was rigidly enforced. This problem would likely be less severe with a program which stabilized cocoa earnings rather than one which raised cocoa earnings. Despite the difficulties envisaged, producers of cocoa are likely to benefit from a workable commodity agreement on cocoa.

The International Cocoa Agreement,[2] which was proposed in Geneva on 20 October 1972, came into force on 30 April 1973 and was to remain in force for three years. The producing countries and most of the importing countries have ratified this Agreement. However, the leading importer of cocoa, the United States, has not yet ratified the Agreement.

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[1] F.H. Weymar, The Dynamics of the World Cocoa Market (Cambridge, Mass.: The M.I.T. Press, 1968).

[2] International Cocoa Agreement, op. cit.

The implied objectives of the Agreement are to stablize and increase the export earnings of producing countries by instituting a buffer stock system. The Agreement seeks to prevent serious fluctuations in the prices of cocoa by maintaining a minimum price for cocoa beans of 23 U.S. cents per pound and a maximum price of 32 U.S. cents per pound. To prevent surpluses of cocoa beans at harvest time and possible shortages during the off-season, the Agreement proposed to set up a buffer stock. The fact that the Agreement has been in force for a fairly short period of time and that the prices of cocoa from 1973 onward were not available at the time of this study make it difficult to comment on how effective this Agreement has been in stabilizing or increasing cocoa prices.

In conclusion, there is a case for the establishment of a commodity agreement on cocoa. A workable agreement is feasible. However, any agreement to which the major importers are not party and also which is not binding on the contracting parties is not likely to succeed.

Recommendations

The results indicate that the demand function for cocoa is price inelastic in both Canada and the United States. This inelasticity suggests that a fall in price is not likely to result in a proportionate increase in the total consumption of cocoa. Again, an increase in income

would result in less than a proportionate increase in the consumption of cocoa in its non-beverage use for both Canada and the United States. For the beverage use, an increase in income is likely to lead to a fall in the consumption of cocoa for the United States. Since cocoa exports are a major source of foreign exchange earnings for a number of exporting countries, this feature suggests that major increases in export earnings will not be likely from the export of this commodity. One line of action for the exporting countries to whom earnings from cocoa are important is for them to attempt to process a greater portion of cocoa beans into semi-processed or finished products. As a means of attempting to expand the demand for cocoa beans, research should be carried out to find more uses for cocoa. There should also be more sales promotion. These measures could well be carried out by group action of the producing countries as part of their joint activities under a commodity agreement.

A Note on U.N.C.T.A.D. Proposals

The United Nations Conference for Trade and Development proposes an overall integrated approach to the commodity problems of developing countries. These proposals[1] are:

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[1] U.N.C.T.A.D., Towards an Integrated Commodity Policy, U.N.C.T.A.D. Briefing Paper No. 1 (Geneva: U.N.C.T.A.D., Information Unit, June, 1975), p. 2.

(1) The establishment of international stocking arrangements;

(2) A common financial funding;

(3) A network of supply and purchase commitments;

(4) As a residual measure, a system of compensatory financing;

(5) A new breakthrough in the field of processing of primary products by the developing countries;

(6) Commodity price indexation of linking the prices of developing countries' exports to the prices of their imports from the developed countries.

The author is of the opinion that the third proposal would not be in the interest of producing countries in the long run. As new resources and technologies are developed, a commodity's importance to the economy may decline and it may not be economical to continue its production. The sixth proposal also seems too ambitious. So far "few commodity agreements have been concluded and few are working satisfactorily. Out of the six at present in force -- covering wheat, olive oil, tin, sugar, coffee and cocoa -- only those for tin and cocoa contain provisions on prices and export quotas."[1] Since there are few present agreements on prices, it is doubtful whether there will be any agreements on indexation.

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[1] Ibid., p. 1.

Summary

This study has attempted to present some insights regarding the behaviour of some of the important variables affecting the demand for cocoa in Canada and the United States. In pursuing this objective, the relationships between the consumption of cocoa and the effects of changes in income, prices of cocoa, population, and the prices of related goods were examined from 1950 to 1972 for both Canada and the United States. The price and income elasticities of demand for cocoa were calculated. Also calculated were the cross-price elasticities of demand for cocoa with respect to the prices of sugar, soybean oil, coffee, and tea.

The results[1] suggested that there is a relatively inelastic demand function for both the beverage and non-beverage uses of cocoa in both Canada and the United States. For the non-beverage use of cocoa, the calculated price elasticity of demand coefficient was $^{-}0.2643$ for Canada. The calculated own-price elasticity of demand for cocoa ranged from $^{-}0.2856$ to $^{-}0.0963$ for the United States. However, the contribution to the R^2 in all the models by the retail price of cocoa variable[2] was low.

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[1] The highest contribution to the R^2 by the retail cocoa price variable was 24.85 percent in Model 7.

[2] Only the estimated coefficients which were significant were discussed.

The magnitudes of the two significant estimated income elasticity coefficients in the formulations for the non-beverage use of cocoa were 0.4093 and 0.1797 for Canada and 0.0129 and 0.0993 for the United States. For the beverage use of cocoa, the magnitudes of these coefficients ranged from $^{-}0.0353$ to $^{-}0.0130$ for the United States. For Canada, the value obtained was 0.4118. The analysis suggests that cocoa is a normal good in both uses for Canada. For the United States, cocoa is a normal good in its non-beverage uses and an inferior good in its beverage use.

The signs of the two significant estimated cross-price elasticities of demand for cocoa with respect to the retail prices of sugar suggest that sugar is a substitute for cocoa in Canada. The magnitudes of the two significant estimated cross-price elasticities were 0.7597 and 0.6706. From the manufacturing point of view, these inputs are complements up to some point, and beyond this point they become partial substitutes. From the point of view of final consumers, though chocolate products generally also contain sugar, there are non-cocoa and non-chocolate products which also use sugar. The evident substitute relationship between cocoa and sugar may, therefore, not be anomalous.

Estimates of the cross-price elasticity of demand for cocoa with respect to the price of soybean oil indicated that soybean oil is a substitute for cocoa (that is, for cocoa butter) in Canada. The two significant calcu-

lated cross-price elasticities of demand for cocoa with respect to soybean oil prices were 0.2294 and 0.2218. However, the soybean oil price variable explained only 1.16 percent of the variation in the total consumption of cocoa for Canada.

Only two of the cross-price elasticity of demand coefficients for cocoa with respect to the wholesale prices of coffee which were calculated for the United States were significantly different from zero. These two estimates carried signs opposite to those expected. The calculated cross-price elasticities were ⁻0.2500 and ⁻0.2034. The negative signs suggest that cocoa and coffee are complements. A possible explanation for the complementarity relationship existing between cocoa and coffee may be that people who drink cocoa tend also to drink coffee.

The majority of the calculated coefficients of the cross-price elasticity of demand for cocoa with respect to the wholesale prices of tea for the United States were highly significant, though these coefficients also had signs opposite to those expected. These estimates ranged from ⁻0.5526 to ⁻0.2396. The negative signs imply that a complementary relationship between cocoa and tea applies. It may be that people who drink cocoa tend also to be tea-drinkers. The magnitudes of the elasticities suggest that this complementary relationship is fairly weak.

In one instance, the results obtained from this study

correspond closely to Behrman's[1] results. The calculated price elasticity of demand for cocoa in its non-beverage use for the United States (⁻0.1170) corresponds to Behrman's calculation of ⁻0.11 for the United States. There were conflicts in the other results. Behrman's estimates of the income elasticities of demand for cocoa for the United States were ⁻1.58 and ⁻1.97. For Canada, his estimate was 0.72. The results obtained from this study were 0.2075 and 0.0993 for the United States and 0.4093 and 0.1797 for Canada. The cross-price elasticities of demand for cocoa with respect to sugar prices as estimated by Behrman were ⁻0.49, ⁻0.23, and 0.08 for the United States. These estimates for the United States were not significant in this study. For Canada, Behrman's calculation was 0.08. The results obtained in this study were 0.7597 and 0.6706. Behrman's estimates of the cross-price elasticity of demand with respect to soybean oil price were 0.19 for the United States and 0.43 for Canada. Two estimates of the cross-price elasticity obtained in this study were 0.2294 and 0.2218 for Canada. These coefficients were not significant for the United States. The differences in these results may be due to the differences in the estimation methods and the time periods under study. This study considered the period from 1950 to 1972, while the period for Behrman's

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[1] J.R. Behrman, "Cocoa: A Study of Demand Elasticities in the Five Leading Countries, 1950-1961," Journal of Farm Economics, Vol. 47 (May, 1965), p. 416.

study was from 1950 to 1961. Only the ordinary least square estimation approach was used in this study. Behrman used the instrumental variable estimation method in addition to the ordinary least squares approach.

Summary of Recommendations

In summary, there should be further processing of cocoa beans in the producing countries into semi-processed and finished products -- at least to the extent that these producing countries import such cocoa products. There should be further emphasis on research into expanding the uses of cocoa. More emphasis on promotion of the present uses of cocoa products is required. A workable commodity agreement on cocoa would be of particular benefit to the producing countries and should be pursued.

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APPENDIX A

LOGARITHMIC EQUATIONS OF THE MODELS FORMULATED IN CHAPTER III

The logarithmic formulations of the models which attempted to explain the variation in the levels of retail price and the total and per capita consumption of cocoa in its non-beverage use are presented in this Appendix. This Appendix also presents the logarithmic forms of the models which were postulated to explain the variation in the levels of the beverage consumption of cocoa. All these models were tested on both the Canadian and the United States data. The variables in the models are as defined in Chapter III.

Single-Equation Models: Non-Beverage Use of Cocoa

Model 1

$$\log Y_1 = \log b_0 + b_1 \log Y_2 + \log u \qquad (1)$$

Model 2

$$\log Y_2 = \log b_0 + b_2 \log Y_1 + \log u \qquad (2)$$

Model 3

$$\log Y_2 = \log b_0 + b_2 \log Y_1 + b_3 \log X_3 + \log u \qquad (3)$$

Model 4

$$\log Y_2 = \log b_0 + b_2 \log Y_1 + b_3 \log X_3 + b_4 \log X_4 + \log u \quad (4)$$

Model 5

$$\log Y_2 = \log b_0 + b_2 \log Y_1 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + \log u \quad (5)$$

Model 6

$$\log Y_2 = \log b_0 + b_2 \log Y_1 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + \log u \quad (6)$$

Model 7

$$\log Y_3 = \log b_0 + b_2 \log Y_1 + b_8 \log X_8 \quad (7)$$

Single Equation Models: Beverage

Use of Cocoa

Model 1

$$\log Y_2 = \log b_0 + b_9 \log X_9 + b_{10} \log X_{10} + b_{11} \log X_{11} + \log u \quad (8)$$

Model 2

$$\log Y_2 = \log b_0 + b_3 \log X_3 + b_9 \log X_9 + b_{10} \log X_{10} + b_{11} \log X_{11} + \log u \quad (9)$$

Model 3

$$\log Y_2 = \log b_0 + b_3 \log X_3 + b_4 \log X_4 + b_9 \log X_9 + b_{10} \log X_{10} + b_{11} \log X_{11} + \log u \quad (10)$$

Model 4

$$\log Y_2 = \log b_0 + b_3 \log X_3 + b_4 \log X_4 + b_7 \log X_7 + b_9 \log X_9 + b_{10} \log X_{10} + b_{11} \log X_{11} + \log u \quad (11$$

APPENDIX B

AVERAGE ANNUAL RETAIL PRICES OF COCOA, SUGAR, AND SOYBEAN OIL, CANADA AND U.S., 1950-1972

TABLE 1

AVERAGE ANNUAL RETAIL PRICES OF COCOA, SUGAR, AND SOYBEAN OIL AT NEW YORK FOR CANADÀ AND THE UNITED STATES, 1950-1972

Year	Retail Prices of Cocoa (Col. 1)	Retail Prices of Sugar (Col. 2)	Retail Prices of Soybean Oil (Col. 3)
		U.S. Cents Per Pound	
1950	32.1	7.84	23.6
1951	35.5	8.21	16.6
1952	35.4	8.45	18.6
1953	37.1	8.55	19.0
1954	57.8	8.55	18.8
1955	37.4	8.42	18.7
1956	27.3	8.59	18.3
1957	30.6	8.97	16.6
1958	44.3	9.10	14.8
1959	36.6	9.14	10.1
1960	28.4	9.25	13.1
1961	22.6	9.21	11.4
1962	21.0	9.41	10.7
1963	25.3	11.70	10.3
1964	23.4	10.47	13.2
1965	17.3	10.02	13.8
1966	24.4	10.15	12.1
1967	29.1	10.41	10.7
1968	34.4	10.60	10.2
1969	45.7	11.22	12.9
1970	34.2	11.74	15.6
1971	26.8	12.24	17.8
1972	32.3	12.83	17.8

SOURCE: Column (1): Food and Agriculture Organization, Cocoa Statistics (Rome: F.A.O., Quarterly Issues).

Column (2) and (3): United States Department of Agriculture, Agricultural Statistics (Washington, D.C.: U.S.D.A., Annual Issues).

APPENDIX C

AVERAGE ANNUAL WHOLESALE PRICES OF COCOA, COFFEE, AND TEA, CANADA AND U.S., 1950-1972

TABLE 1

AVERAGE ANNUAL WHOLESALE PRICES OF COCOA, COFFEE, AND TEA, CANADA AND THE UNITED STATES, 1950-1972

Year	Wholesale Prices of Cocoa (Col. 1)	Wholesale Prices of Coffee (Col. 2)	Wholesale Prices of Tea (Col. 3)
	U.S. Dollars Per 100 Pounds		
1950	32.05	50.91	52.00
1951	35.60	54.30	49.70
1952	35.40	54.12	41.60
1953	37.12	58.46	44.10
1954	57.74	78.30	65.60
1955	37.40	57.00	65.50
1956	27.10	58.40	50.00
1957	30.40	57.30	55.70
1958	43.90	48.41	59.50
1959	33.60	36.97	56.20
1960	28.60	36.60	58.40
1961	22.70	36.01	48.80
1962	20.80	33.96	51.70
1963	25.33	34.11	53.10
1964	23.43	47.36	53.00
1965	17.28	44.78	54.00
1966	24.43	40.79	48.20
1967	29.07	37.93	45.93
1968	34.40	37.48	46.00
1969	45.68	40.35	42.60
1970	34.17	53.94	45.80
1971	26.77	45.17	48.70
1972	32.26	50.74	50.70

SOURCE: Columns (1-3): International Monetary Fund, International Financial Statistics (Washington, D.C.: I.M.F., Annual Issues).

APPENDIX D

AVERAGE ANNUAL PER CAPITA AND TOTAL CONSUMPTION OF COCOA, CANADA AND U.S., 1950-1972

TABLE 1

AVERAGE ANNUAL PER CAPITA AND TOTAL CONSUMPTION OF COCOA, CANADA AND THE UNITED STATES, 1950-1972

Year	Canada		United States	
	Per Capita Consumption (Col. 1)	Total Consumption (Col. 2)	Per Capita Consumption (Col. 3)	Total Consumption (Col. 4)
	(Green Beans - in Pounds Per Annum)	(Thousand Tons)	(Beans - Equivalent in Pounds Per Annum)	(Million Pounds)
1950	3.33	20.73	4.4	672
1951	2.22	14.16	3.8	591
1952	2.70	17.77	3.8	582
1953	3.02	20.38	3.8	603
1954	2.94	20.45	3.3	525
1955	2.71	19.31	3.2	527
1956	2.59	18.97	3.7	612
1957	2.81	21.27	3.8	648
1958	2.49	19.33	3.3	571
1959	2.77	22.00	3.5	615
1960	2.86	23.21	3.6	638
1961	3.16	26.15	3.9	707
1962	2.79	23.58	3.8	701
1963	3.34	28.72	3.9	723

TABLE 1 (CONTINUED)

Year	Canada		United States	
	Per Capita Consumption (Col. 1)	Total Consumption (Col. 2)	Per Capita Consumption (Col. 3)	Total Consumption (Col. 4)
	(Green Beans - in Pounds Per Annum)	(Thousand Tons)	(Beans - Equivalent in Pounds Per Annum)	(Million Pounds)
1964	2.76	24.21	3.9	739
1965	3.18	28.39	4.0	779
1966	2.68	24.38	4.2	814
1967	3.11	28.01	4.0	829
1968	3.08	28.96	4.0	844
1969	3.05	29.10	3.9	782
1970	3.12	30.15	3.9	797
1971	3.50	34.26	4.0	812
1972	3.76	37.26	4.4	913

SOURCE: Column (1): Statistics Canada, Apparent Per Capita Domestic Disappearance of Food in Canada, Cat. No. 32-226 (Ottawa: DBS, Monthly Issues).

Column (2): Statistics Canada, Quarterly Reports on Processed Foods, Cat. No. 32-007 (Ottawa: DBS, Quarterly Issues).

Column (3): United States Department of Agriculture, Food Consumption, Prices, Expenditures (Washington, D.C.: U.S.D.A., December, 1974), p. 36.

Column (4): Ibid., p. 65.

APPENDIX E

AVERAGE ANNUAL PER CAPITA AND NATIONAL INCOME IN CURRENT DOLLARS IN CANADA AND IN THE UNITED STATES, 1950-1972

TABLE 1

AVERAGE ANNUAL PER CAPITA AND NATIONAL INCOME IN CURRENT DOLLARS IN CANADA AND IN THE UNITED STATES, 1950-1972

	Canada		United States	
Year	Per Capita Income (Col. 1)	National Income (Col. 2)	Per Capita Income (Col. 3)	National Income (Col. 4)
	(C. $ Per Year)	(Million $ Per Year)	(U.S. $ Per Year)	(Billion $ Per Year)
1950	1,349	18,491	1,877	241.1
1951	1,545	21,640	2,126	278.0
1952	1,701	24,588	2,199	291.4
1953	1,740	25,833	2,284	304.7
1954	1,695	25,918	2,224	303.1
1955	1,817	28,528	2,408	331.0
1956	1,934	32,058	2,466	350.8
1957	2,018	33,513	2,585	366.1
1958	2,036	34,777	2,552	367.8
1959	2,108	36,846	2,722	400.0
1960	2,147	38,359	2,788	414.5
1961	2,174	39,646	2,830	427.3
1962	2,310	42,927	3,002	457.7
1963	2,429	45,978	3,111	481.9
1964	2,607	50,280	3,272	518.1
1965	2,818	55,364	3,525	564.3
1966	3,089	61,828	3,808	620.6
1967	3,259	66,409	3,985	653.6
1968	3,506	72,586	4,306	711.1
1969	3,801	79,815	4,590	766.0
1970	4,020	85,610	4,769	798.6
1971	4,330	93,402	5,098	855.7
1972	4,737	103,407	5,531	--

SOURCE: Col. (1): Statistics Canada, Canadian Statistical Review (Ottawa: Statistics Canada, Annual Issues).

Col. (2): Statistics Canada, Canada Year Book, Cat. No. 11-202 (Ottawa: DBS, Annual Issues).

Cols. (3) and (4): United States Department of Commerce, Statistical Abstract of the United States (Washington, D.C.: U.S.D.C., Annual Issues).

APPENDIX F

NATIONAL POPULATION LEVELS, CANADA AND THE UNITED STATES, 1950-1972

TABLE 1

NATIONAL POPULATION LEVELS FOR CANADA AND THE UNITED STATES, 1950-1972

Year	Canada (Col. 1)	United States (Col. 2)
	(Thousands)	(Thousands)
1950	13,712	152,271
1951	14,009	154,878
1952	14,459	157,553
1953	14,845	160,184
1954	15,287	163,026
1955	15,698	165,931
1956	16,081	168,903
1957	16,610	171,984
1958	17,080	174,882
1959	17,483	177,830
1960	17,870	180,671
1961	18,238	183,691
1962	18,583	186,538
1963	18,931	189,242
1964	19,290	191,889
1965	19,644	194,303
1966	20,015	196,560
1967	20,378	198,712
1968	20,701	200,706
1969	21,001	202,677
1970	21,297	204,875
1971	21,569	207,045
1972	21,830	208,842

SOURCE: Col. (1): Statistics Canada, Annual Estimates of Population, Canada and Provinces, Cat. No. 11-003 (Ottawa: DBS, Annual Issues).

Col. (2): United States Department of Commerce, Statistical Abstract of the United States (Washington: D.C.: U.S.D.C., Annual Issues).